DOCUMENT RESUME

ED 045 831 08 VT 012 214

AUTHOR Prediger, Dale J.
TITLE Validation of Counseling-Selection Data for Vocational School Students. Final Report.
INSTITUTION Toledo Univ., Ohio.
SPONS AGENCY Office of Education (DHEW), Washington, D.C. Bureau of Research.
BUREAU NO BR-5-1169
PUB DATE Jul 70
GRANT OEG-3-6-051169-0379
NOTE 103p.

EDRS PRICE EDRS Price MF-$0.50 HC-$5.25
DESCRIPTORS *Computer Oriented Programs, Data Collection, Discriminant Analysis, *Guidance Programs, *Information Science, *Occupational Guidance, *Secondary School Students, Statistical Analysis, Tests, Test Validity, Vocational High Schools

ABSTRACT

The general objectives were to develop and implement computer-based procedures for obtaining validated data on the characteristics of vocational school students, and to convert this data into counseling information. To do this, two types of data information conversion procedures were used: discriminate analysis and regression analysis. Scores from 36 aptitude, interest, and personality measures were accumulated for approximately 1,600 prospective vocational high school students as well as a progress record for each of these students while attending the vocational high school. Multivariate analyses conducted on antecedent and criterion data formed the bases for data information conversion procedures used in the field tests involving 900 prospective students. Results of the study support the development of a generalized system of computer-based procedures for data information conversion as both feasible and desirable. Work was started on a generalized Test Validation and Information Feedback System which is scheduled to be operational by late 1970. Project activities will continue with local support. (Author)

EDO 458831

BR5-1169
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FINAL REPORT

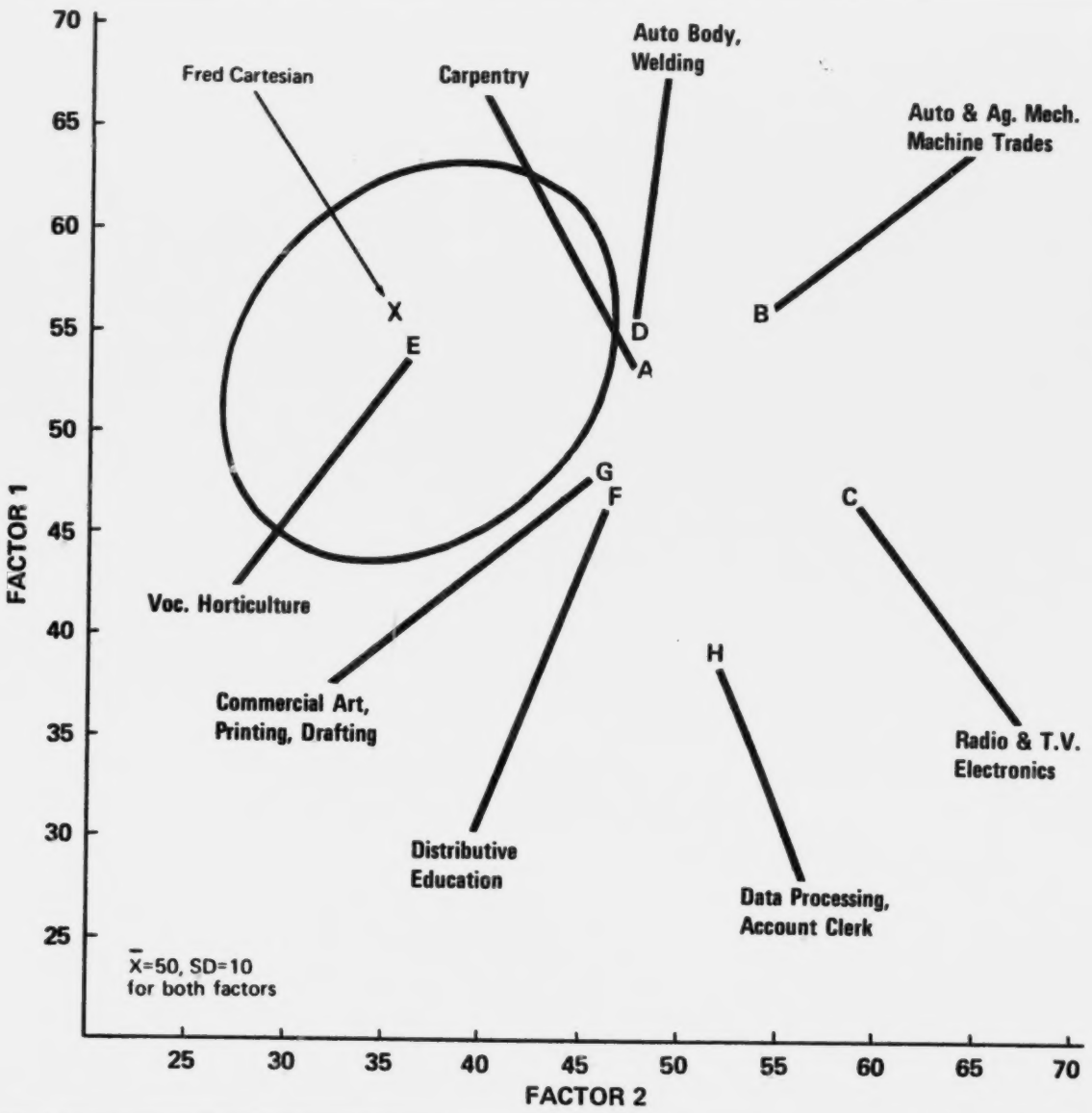
Project No. 5-1169

Grant No. OEG-3-6-051169-0379

VALIDATION OF COUNSELING-SELECTION DATA

For

VOCATIONAL SCHOOL STUDENTS



June, 1970

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

Office of Education, Bureau of Research

VT012214

EDO 45831

Final Report

Project No. 5-1169
Grant No. OEG-3-6-051169-0379

VALIDATION OF COUNSELING-SELECTION DATA FOR VOCATIONAL SCHOOL STUDENTS

Dale J. Prediger

University of Toledo

Toledo, Ohio

July 1970

The research reported herein was performed pursuant to a grant with the Office of Education, U.S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

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PREFACE

This report covers activities in one phase of the project entitled "Validation of Counseling-Selection Data and Evaluation of Supplementary Programs for Vocational School Students." The supplementary program phase of the project was terminated in November of 1968 upon submission of an interim report entitled "Supplementary Programs for Vocational Education." The activities and findings of the validation phase of the project are described in the report that follows.

More than four and one-half years have passed since project activities were initiated. It is impossible to abstract the complex interplay of professional and personal contributions to the project that have been made during this time by staff members, colleagues, family, and friends. No man is an island--not even a research project director. Many persons have made contributions that were essential parts of the whole. Only those persons most closely associated with project activities are recognized here.

A key factor in the entire undertaking was the leadership and cooperation provided by the administrative staff of the Penta-County Vocational School. Dr. William Ramsey, Superintendent of Schools when the project began, and Dr. Jacob See, current Superintendent, both maintained an atmosphere conducive to innovation, even though maintaining the status quo would have been much easier. The leadership and skill in interpersonal relations provided by Louise Fought and Leonard Kingsley during the years they spent on the project firing line were invaluable. Special thanks are also owed to the counselors in Penta-County District high schools and to the Penta-County enrollees from these schools. The long hours spent on the giving and receiving end of psychological testing are impossible to repay. One can only hope that the information gained as a result will be useful to future enrollees.

The project is especially indebted to Eva Carpenter, Arlene Kirkland, Bob Eigensee, and John Szabo. The willingness of these counselors to participate in the initial project field tests provided the touch of reality that was essential to project reporting procedures.

Several research and administrative assistants have been involved, over the course of the project, in the day-to-day detail of making things happen. Contributions that often went beyond the call of duty were made by Gerald Nusbaum, Beverly Damrauer, Marcia Tittle, Rebecca Roush, Phyllis Andre, and Linda Erwin. Finally, a very special debt of gratitude is owed to Sue McCue Nusbaum--who served for over four years in the multiple capacity of project secretary, administrative assistant, associate director, tab machine operator, and girl Friday.

Dale Prediger
July, 1970

TABLE OF CONTENTS

	Page
PREFACE	ii
LIST OF TABLES	iv
LIST OF FIGURES	vi
SUMMARY	1
DATA-INFORMATION CONVERSION IN TEST INTERPRETATION	3
PROBLEM	15
PROCEDURES	18
RESULTS AND CONCLUSIONS	23
DISCUSSION	48
REFERENCES	52
APPENDIX A: TVIFS--Test Validation and Information Feedback System	57
APPENDIX B: Manual for Interpretation of Results	59
APPENDIX C: Surveys of Counselor and Student Reactions to Field Tests	79
APPENDIX D: Supplementary Data	86
APPENDIX E: First Two Profiles in Similarity Score Profile Series	96
ERIC RESUME	99

LIST OF TABLES

TABLE		Page
1	Final Grouping of Vocational Program Areas	21
2	Vocational Program Areas Used in Separate Analyses of Aptitude, Interest, and Personality Measures	24
3	Results of Wilks' Lambda Test for Group Differentiation	26
4	Chi Squares Indicating Relative Differentiation of Groups by Discriminant Factors	27
5	Aptitude Variable Correlations with First Two Factors	29
6	Interest Variable Correlations with First Two Factors	30
7	Personality Variable Correlations with First Two Factors	31
8	Correlations of Aptitude and Interest Variables Used in Final Analyses with First Two Factors	32
9	Correlations Between Aptitude Variables and Vocational Course GPA	42
10	Multiple Correlations Between Aptitude Variables and Vocational Course GPA	43
11	Aptitude Variable Correlations with Third and Fourth Factors	87
12	Interest Variable Correlations with Third and Fourth Factors	88
13	Personality Variable Correlations with Third and Fourth Factors	89
14	Correlations of Aptitude and Interest Variables Used in Final Analyses with Third and Fourth Factors	90
15	Distribution of Vocational Program Area Means on First Four Aptitude Factors	91
16	Distribution of Vocational Program Area Means on First Four Interest Factors	92

TABLE

Page

17 Distribution of Vocational Program Area Means on First Four Personality Factors 93

18 Distribution of Vocational Program Area Means on First Four Factors Obtained in Final Analyses 94

19 Stanine Norms for All Programs at Penta-County 95

LIST OF FIGURES

FIGURE		Page
1	Similarity Score Profile for Fred Cartesian	8
2	Distribution of M-MF Analysis Groups on First Two Aptitude Factors	33
3	Distribution of M-MF Analysis Groups on First Two Aptitude Factors	34
4	Distribution of M-MF Analysis Groups on First Two Interest Factors	35
5	Distribution of F-MF Analysis Groups on First Two Interest Factors	36
6	Distribution of M-MF Analysis Groups on First Two Personality Factors	37
7	Distribution of F-MF Analysis Groups on First Two Personality Factors	38
8	Similarity Score Profiles for Penta-County Vocational Areas, Chart IA: Male and Mixed Groups	39
9	Centour Score Profiles for Penta-County Vocational Areas, Chart IB: Female and Mixed Groups	40
10	Distribution of M-MF Member-Nonmember Analysis Groups on First Two Aptitude-Interest Factors	49
11	Distribution of F-MF Member-Nonmember Analysis Groups on First Two Aptitude-Interest Factors	50

SUMMARY

Validation of Counseling-Selection Data for
Vocational School Students

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The general objectives of this project were to develop and implement computer-based procedures for obtaining validated data on the characteristics of vocational school students and to convert this data into information that can be used by counselors in helping students select an appropriate vocational education program. The rationale for project activities and data-information conversion procedures can be summarized in the following eight points:

1. Information from tests, when viewed in the context of decision theory, can play an important role in educational and vocational development.

2. This role is primarily one of stimulating and facilitating exploratory behavior.

3. Two data-information conversion procedures--similarity (centour) scores and success estimates--are crucial to this role.

4. On the basis of both logical and technical considerations, similarity scores are more appropriate than success estimates in stimulating and facilitating exploratory behavior. Success estimates represent one of many things to be considered in the process of exploration.

5. Similarity scores eliminate much of the guesswork inherent in test profile interpretation.

6. Statistical and graphical procedures are available to facilitate understanding of the reasons underlying a given counselee's similarity scores, thus avoiding the take-it-or-leave-it aspects of test interpretation based on similarity scores alone.

7. These procedures can also facilitate use of test data to initiate changes in counselee characteristics and/or the characteristics of groups representing various choice options, rather than merely to represent the status quo.

8. Data-information conversion procedures must rely heavily on the availability of local validity data.

Project activities were conducted in an area vocational school district drawing students from 14 feeder high schools. Scores from 36 aptitude, interest, and personality measures were accumulated for each of approximately 1600 students enrolling in the vocational school as juniors or seniors from September, 1966 through September, 1968. The interest and aptitude measures were administered at least seven months prior to vocational school entry,

while the personality measures were obtained shortly after entry. Prospective vocational school students had 24 vocational programs from which to choose. Almost all of these involved two years of concentrated course work and shop experience.

For purposes of analysis, the 24 vocational programs were organized into 12 groups: 4 enrolling primarily males, 4 enrolling primarily females, and 4 enrolling a substantial number of males and females. Success and satisfaction criteria were used to identify approximately 1,000 students eligible for these analysis groups. A prototype package of computer programs was developed to facilitate data collection, analysis, and data-information conversion. Separate analyses run on the eight male and mixed groups and the eight female and mixed groups involved criterion data available at the end of the 1966-67, 1967-68, and 1968-69 school years.

Multivariate analyses of variance and multiple discriminant analyses were used to determine the extent and manner in which students in the various vocational programs differed and to identify the variables making the major contributions to program differentiation. The aptitude and the interest measures appeared to be substantially more effective than the personality measures. A combination of ten of the most effective aptitude and interest measures was used during the 1969-70 school year to provide similarity score reports for more than 900 prospective vocational school students attending 12 field-test high schools. As a result of regression analyses, counselors in the field-test schools also had single- and double-entry experience tables based on the best aptitude predictors. Prior GPA was the best single predictor of vocational program grades in 11 of the 12 program groups. However, there was considerable evidence of differential validity in the best two-variable combination of predictors.

The following general conclusions are warranted by results of the analyses and field trials:

1. Successful and satisfied students enrolled in diverse vocational education programs can be differentiated by aptitude, interest, or personality measures obtained prior to or shortly after entry into the programs.

2. Similarity scores and similarity score profiles represent effective techniques for translating data on these differences into information that is helpful to prospective vocational school students.

3. Useful estimates of vocational program success can be conveyed to students in the form of experience tables based on the best predictors in a comprehensive battery of aptitude measures.

4. The development of a generalized system of computer-based procedures for data-information conversion is both feasible and desirable.

Project activities will continue with local support. Additional evaluations and analyses are scheduled for the summer of 1971. On the basis of the experience and results obtained in this project, development of a generalized "Test Validation and Information Feedback System" (TVIFS) was begun with support from the Ohio Board of Regents. Major phases of TVIFS are scheduled to become operational by September, 1970.

Data-Information Conversion in Test Interpretation

This report is concerned with objective procedures for converting test scores and other data on counselee characteristics into information that is relevant to the counselee's educational and vocational plans, decisions, or problems. Although research project activities were conducted in a vocational school setting, the data-information conversion procedures that were demonstrated have applicability wherever tests are interpreted. For this reason, a discussion of data-information conversion in testing precedes the report of project activities and findings.

Validity studies are crucial to the use of test results in counseling. However, a statistically significant correlation coefficient obtained from a validity study completed somewhere, somehow, and some time ago, is seldom of direct help to the counselor who has Fred and a set of test scores before him. While it is true that an accumulation of validity studies performed within a theoretical framework may support various uses of a particular test, the task of converting a counselee's test scores into usable information is left undone. Typically, the counselor can find the standing of a counselee in some norm group--but then he is on his own. Professional knowledge, clinical judgment, and personal sensitivity will always play crucial roles in test interpretation. However, objective data-information conversion procedures can make it easier for the counselor to approach test interpretation more as a science than as an exercise in tea leaf reading. Just what does a percentile rank of 63 on the XYZ Mechanical Aptitude Test say to Fred and his counselor?

Local validity data and decision-making

It has been almost 15 years since Dyer (1957) made a convincing case for local studies of test validity. Dyer's voice was only one of a chorus of measurement specialists who cautioned test users about accepting tests on the basis of face validity or assuming that a moderately successful validity study conducted at Forefront High School, Blivot Industries, or the Fortuitous Diagnostic Clinic provided sufficient evidence that a test would be useful in their setting and for their purposes. Dyer saw little help with development of local validity data coming from the statisticians and professional researchers, who are typically ". . .disinclined to get involved with the messy and peculiar data that turn up in local school systems [p. 163]." Instead, he felt the job must fall to the local practitioner.

The same thought was reflected eight years later by Clarke, Gelatt, and Levine (1965), who placed the need for local validity data in the context of decision theory and presented a decision-making paradigm for local guidance research. Attention was focused on the process of decision-making, with information on the possible outcomes of various courses of action being seen as a necessary if not sufficient condition for wise decisions. Examples of local validity studies conducted in the Palo Alto, California schools were given to illustrate the development of objective probabilities useful in educational planning. As with Dyer, use of experience (expectancy) tables was emphasized. Subsequent articles (Gelatt &

Clarke, 1967; Katz, 1966, 1969; Thoresen & Mehrens, 1967) elaborated on the role of objective probabilities in decision-making, the influence of these probabilities on subjective probabilities, and the interaction between subjective probabilities, choice option utilities, and personal values.

Katz (1963, 1966), in particular, was careful to show how the decision-making process is related to the broader process of vocational development. Results from the massive Project TALENT validation studies have also been placed within the context of vocational development theory and decision theory (Cooley & Lohnes, 1968). We have passed the era in which the Parsonian concept of test interpretation could be viewed as the epitome of educational and vocational guidance. However, the above studies and formulations leave little doubt about the continued importance of test information in the vocational development process.

To the degree that validity data collected elsewhere are directly applicable to the setting in which the counselor works, the nature of his counselees, and the uses he makes of test results, local validity studies are not needed. However, past research (Bennett, Seashore, & Wesman, 1966; Ghiselli, 1966; Passmore, 1968; Prediger, Waple, & Nusbaum, 1968) indicates that the transferability of validity data from one setting to another is open to serious question and, hence, should be investigated before it is assumed. Work is underway on generalized prediction models (Hoyt, 1968; Novick & Jackson, 1969) that may relax the need for local validity data. In at least two current testing programs (College Entrance Examination Board, 1969; Science Research Associates, 1968), validity pooling procedures have been used to generate locally applicable predictions. However, it remains to be seen whether these procedures will ever be viewed as more than substitutes for the real thing. Certainly, the need for a wide variety of validity studies in a broad range of settings will never be eliminated.

Bridges between data and information

Goldman (1961) described three objective bridges between test scores and their meaning for the counselee: the norm bridge, the regression bridge, and the discriminant bridge. Most of our current data-information conversion procedures consist of some form of the norm bridge. As Goldman notes, the norm bridge is an incomplete bridge, since test norms simply permit one to estimate standing in some group and do not, per se, indicate implications of this standing. The regression bridge, however, is a complete bridge from test score to implication and, as such, readily lends itself to data-information conversion. Usually this is accomplished via experience tables or regression equations. Each can be employed to estimate level of success or the probability of achieving a certain level of success on some criterion variable (e.g., college freshman GPA). The third bridge, the discriminant bridge, noted by Goldman, provides an objective measure of a counselee's similarity to various criterion groups. Discriminant analysis techniques, when combined with the centour score procedures developed by Tiedeman, Bryan, and Rulon (1951), make it possible to compare a counselee's test results with those of various criterion groups along the major dimensions of test data that differentiate the groups.

The complementary nature of similarity and success estimates was first discussed some twenty years ago (Rulon, 1951; Tiedeman et al., 1951). It is unlikely, however, that many practitioners are familiar with the characteristics of similarity (centour) scores or their potential role in test interpretation. These topics have received little attention in testing texts or test interpretation manuals. For this reason and because of the importance of this data-information conversion technique, an illustration involving use of similarity scores in conjunction with success estimates is presented below.

Similarity scores illustrated

Consider the information needs of Fred, a high school student thinking about enrolling in vocational education. On the basis of Fred's high school grade record and the aptitude and interest measures available for him, Fred's counselor might receive a report indicating Fred's similarity to successful and satisfied students in various vocational education programs. In the example that follows, the similarity scores shown in parentheses after each of the vocational programs are on a scale running from 0 to 100 with 100 representing the highest degree of similarity. The closer Fred's scores on the relevant tests are to the test scores of the typical successful and satisfied student in a vocational program, the higher his similarity score will be for that program. Fred's similarity score report might look like this: vocational horticulture (87), carpentry (41), commercial art (28), auto body (26), distributive education (25), auto mechanics (14), radio and TV repair (3), and data processing (1).

Thus, on the basis of the measures used, Fred's aptitudes and interests are most similar to students in vocational horticulture. Carpentry ranks second, and three other programs are in an approximate tie for third. Fred is least similar to students in data processing and radio-TV repair.

In this example, test data have been transformed into information that is directly relevant to one of the major functions of tests in educational and vocational guidance--facilitating exploratory behavior. Fred's counselor might use this information quite advantageously in stimulating Fred to explore the program options available to him. The scores should not be used to tell Fred what to do. Neither should they be used alone. Their potential value lies in suggesting vocational program possibilities that might not have been recognized otherwise. The degree to which Fred explores these possibilities will be a function of his value system and the encouragement and opportunities provided him.

Secondary role of success estimates

Success predictions obtained from regression analysis or expectancy tables can also be used to facilitate exploratory behavior. For example, Fred might be encouraged to explore the vocational programs for which he is predicted to receive the highest grades. However, estimates of success might be more appropriately incorporated into the actual exploration process where they could take their place along with a host of other relevant considerations. After all, Fred may or may not place much value on making high grades. His similarity scores could identify areas in which he would

have a reasonable chance for success. His probable level of success could then be determined upon further exploration. Thus, a two-stage strategy is suggested, with similarity scores being used to stimulate and facilitate exploration and success estimates being one of the many things to be considered during the process of exploration.

The above argument is based on some semblance of logic. However, there are technical reasons for not using success estimates as the primary basis for facilitating exploration. Consider, for example, an experience table showing the relationship between the scores on some test and grades in carpentry. Would it be appropriate to use this table with Sally, Fred's sister? Can Sally be considered to be similar to the group from which the experience table data were obtained? To what degree would the trends shown in the results apply to her? Likewise, to what degree would success predictions in radio-TV repair apply to Fred (similarity score=3)? Can we legitimately use Fred's test scores to predict lab grades in cosmetology? Or, in another context, are we justified in comparing a high school senior's college freshman GPA predictions in engineering, art, education, physical science, and business? These questions, recently discussed by Rulon, Tiedeman, Tatsuoka, and Langmuir (1967), need further investigation. However, it would appear that a "reasonable" degree of similarity might be an appropriate prerequisite for the use of success predictions in counseling.

There is probably little need to mention a second well known difficulty with success predictions, i.e., the criterion problem. Obtaining a suitable measure of success in education and training programs is difficult enough. However, when one moves into the world of work, the problem takes on tremendous proportions (Thorndike, 1963; Thorndike & Hagen, 1969). Not only are there a multitude of occupations and job locations, but also the definition of success becomes infinitely more complex. It is relatively easy, however, to identify persons employed in various occupations or occupational clusters. (Gross selective standards for determining criterion group eligibility could also be applied.) This would be sufficient to permit the application of discriminant analysis and centour score procedures to the available antecedent variables. Data-information conversion would be possible.

Overcoming the profile problem

Judgment of a counselee's similarity to various criterion groups is not new to the field of counseling. Certain commercially-available inventories (e.g., the Strong Vocational Interest Blank and the Kuder Occupational Interest Survey) were constructed so as to directly yield a similarity index. In the case of other tests and inventories, profiles for various criterion groups have often been provided with the expectation that counselors would compare a counselee's profile with the criterion group profiles. Anyone who has engaged in this process needs no description of what has long been known as the profile problem (Tiedeman, 1954).

Similarity scores take the guesswork and eyestrain out of profile comparison. But, unless they are used in conjunction with discriminant analysis procedures, they fail to deal directly with important aspects

of the profile problem, e.g., do the criterion groups actually look different on the measures involved? If so, what are the important measures, and how should they be weighted? Unfortunately, a set of similarity scores can be obtained from purely irrelevant variables.

It is for the above reasons that similarity scores should be used in conjunction with discriminant analysis procedures. These procedures enable one to determine whether the criterion groups are, in fact, differentiated by the measures being used. If so, the measures can be weighted and combined into independent factors (functions) that maximize criterion group differentiation. Furthermore, it is possible to determine how many factors are needed for criterion group differentiation. Thus, one may (and usually will) find that two factors account for most of the discriminatory power of a set of measures when applied to criterion groups relevant to educational and vocational counseling. Finally, it is possible to identify the nature of the factors by noting the measures that correlate highly with them.

Equations resulting from discriminant analysis can be used to calculate criterion group positions on the discriminating factors. These positions, in turn, can be plotted on a coordinate grid with the vertical and horizontal axes representing the two major factors. In the same manner, the factor scores of a given student may be calculated and plotted. The student's position on the coordinate grid may then be compared visually with the criterion group positions.

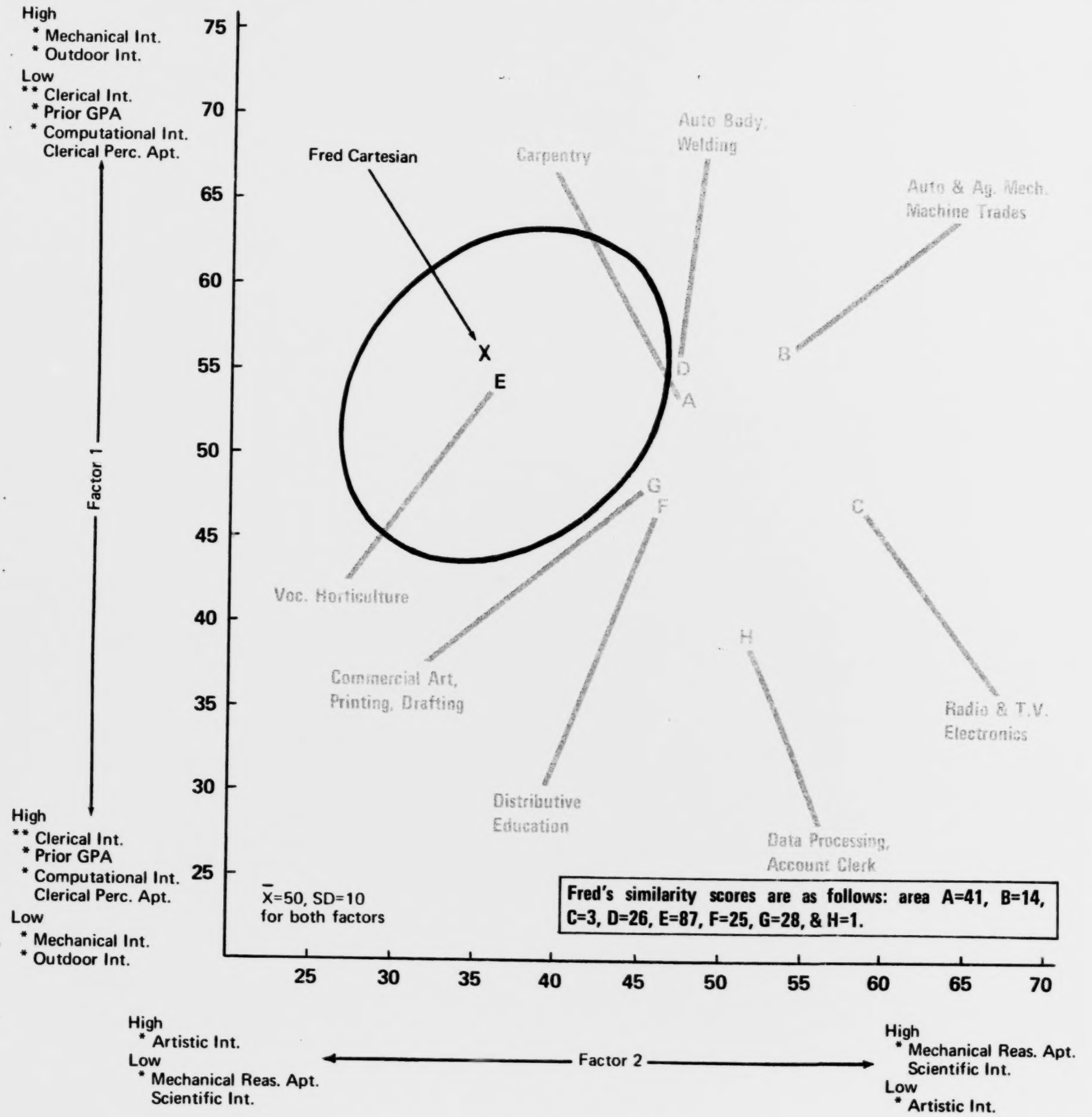
This technique for graphically depicting a student's similarities and dissimilarities was implicit in early work on the profile problem (Tiedeman, 1954) and was specifically suggested more than ten years ago (Whitta, 1957; Dunn, 1959). However, it has been mentioned only occasionally in the professional literature since then (e.g., Baggaley & Campbell, 1967; Cooley & Lohnes, 1968) and has received little attention in testing texts. Rulon and his colleagues (1967) have provided a detailed discussion of the rationale underlying discriminant analysis and similarity score procedures along with ample illustrations of the resulting graphical solution to the profile problem. However, in presenting the illustrations, emphasis was placed on representing the geometry of the statistical procedures. Little attention was given to test interpretation applications of the illustrations.

Data-information conversion via "similarity score profiles"

The graphical procedures described above can serve several important functions in data-information conversion. Application of these procedures to the problem faced by Fred and his counselor--consideration of vocational program options--is illustrated by the similarity score profile presented in Figure 1. Note that the two dimensions or factors that best differentiate the vocational programs are represented by the axes of the coordinate grid. Of the ten aptitude and interest measures used in the analysis on which the profile is based, those having factor correlations with an absolute value of .40 or more are listed as factor anchors. (The following symbols are used to indicate level of correlation: ***=r>.69; **=r of .60-.69; *=r of .50-.59; no *=r of .40-.49.)

Figure 1

Similarity Score Profile for Fred Cartesian



Fred's factor scores of 56 and 36 for Factors 1 and 2, respectively, have been plotted on the coordinate grid along with the mean scores of the eight vocational programs. In several instances, e.g., auto body and welding, related vocational programs have been combined into one group. The ellipse surrounding the vocational horticulture group encloses the factor scores of approximately 50% of the students in the group and is analogous to the scatter diagrams often seen in discussions of correlation. Similar, but not identical, ellipses could be used to represent the scatter of factor scores for the other vocational programs. One ellipse should be sufficient, however, to obtain a good estimate of overlap among the various programs.

Fred's similarity scores have been inserted for ready reference in a box in the lower right-hand section of the coordinate grid. Notice that they are reflected in the relative positions of Fred and the vocational programs on the profile. For example, Fred's position is quite close to that of the vocational horticulture group, the group for which he received his highest similarity score, i.e., 83. On the other hand, programs for which he has low similarity scores are much farther away.

By comparing Fred's position on the profile with the positions of the various vocational programs, one can obtain valuable insights into the reasons underlying Fred's similarity scores. Field trials with potential vocational school students have shown that this is quite important, since use of similarity scores, by themselves, often leaves the counselee with the question, "But why did the scores come out like that?" In Fred's case, we see that both he and the typical horticulture student score only slightly above average on Factor 1, while Factor 2 scores indicate relatively strong artistic interests and relatively low mechanical reasoning aptitude and scientific interests. Fred may wonder why his similarity score for area H was so low. From the profile, we see that the Factor 2 scores for Fred and area H students are relatively far apart. In addition, the position of area H students on Factor 1 suggests that they have stronger clerical skills and interests than Fred. Similar reasoning can be followed in comparisons with the other groups represented on the profile.

In helping Fred understand the possible reasons underlying his similarities and dissimilarities, one is, in a sense, helping him to project certain aspects of his self into the various choice options. This might be viewed as a type of vicarious exploration that tells Fred what persons who have exercised various choice options are like in terms of the characteristics that have been measured. The fact that there is considerable variation in these characteristics among students who have made a specific choice will be clearly evident from the ellipse shown on the profile. If ellipses are shown for all of the vocational programs, overlap among the various groups will also be evident. Criticisms of counseling applications of trait and factor research are sometimes based on the fact that divergencies within criterion groups and similarities among criterion groups are concealed. Similarity score profiles reveal these facts of life. At the same time, useful differences among criterion groups, if present in the data, are presented in a manner that permits the counselee to "try the various groups on for size." Of course, there are more important things for the counselee to consider. However, aptitudes,

interests, and other measurable characteristics should not be ignored until proof exists that they are irrelevant to educational and vocational decision-making. Probably such proof would be contingent upon showing that individual differences do not exist.

It should be noted that an extreme score on any one of the variables shown as factor anchors could, by itself, have a major influence on Fred's factor scores. Hence, Fred's test score reports should be consulted while discussing his similarity score profile. (Fred's counselor would probably want to do this anyway in order to allow Fred to participate in the test interpretation process.) The factor positions of the vocational programs, on the other hand, are unlikely to be subject to the influence of extreme scores on one or two variables. These positions are, after all, based on group means rather than the scores of a single individual. It is well known that the spread of group means on a variable will be much less than the spread of individual scores.

Similarity and the status quo

Once the reasons underlying Fred's similarity scores have been ascertained, it might be possible for Fred and his counselor to develop a program of activities and study that would increase his similarity score for a given criterion group. The feasibility of doing this would, of course, depend on the variables involved. However, the suggested strategy represents one of the few counseling applications of test data that facilitates change in the status quo rather than merely representing it.

There is another strategy that might be used in combating the status quo, in this case, usually in response to the goals of the institution employing the strategy. Suppose a college is unhappy with the characteristics of members of certain curricular groups. For example, its engineering students need more math, or its business students don't know how to spell. As French (1956) has noted, the similarity score technique, when used with unselected criterion groups, might result in encouraging students with similar deficiencies to enter these areas. Use of regression-based success estimates in conjunction with similarity scores would guard against this. In fact, Tatsuoka (1956) has developed an index which combines success and similarity estimates into one, overall probability. The index has considerable promise for placement applications. However, guidance applications would appear to be limited because the joint index makes it impossible for a counselee to place separate values on the success and similarity estimates. Instead, he is confronted with a single number somewhat analogous to a joint index of height and weight.

Two additional procedures might be employed by the college to combat possible perpetuation of curricular group deficiencies through use of similarity scores. Both involve the strategy of redefining the criterion groups. The first, an empirical procedure, involves the selection of criterion group members according to predetermined definitions of satisfactoriness. Thus, engineering students with a poor math background and business students who flunk the freshman English course could be eliminated from the criterion groups. The second, ad hoc, procedure for redefining criterion groups involves the arbitrary assignment of group

position on the test variables or factors that are thought to be important. For example, current engineering students might be assigned a much higher mean on a math proficiency exam than they actually have. Or, the position of the mechanics and machine trade group (area B) shown in Figure 1, might be moved to the right on Factor 2, thus requiring counselees to have a higher level of mechanical reasoning aptitude and scientific interest in order to appear similar. In each case, parallel adjustments could be made in the calculation of similarity scores. Further discussion of this strategy for combating the status quo has been provided by Rulon et al., (1967).

Some technical considerations

One obvious limitation of similarity score profiles is the difficulty in representing more than two test or factor dimensions at one time. Discriminant analysis, fortunately, results in a reduction in the number of dimensions needed to represent criterion group differentiation. Usually two factors are sufficient. Nevertheless, it is possible to use the similarity score profile technique with three factors by developing a series of profiles representing group positions on the first two factors for successive values of the third. A counselee's position on the first two factors could then be plotted on the coordinate grid appropriate to his third factor score. The appearance of the profile would be exactly as illustrated in Figure 1, except that a separate linear scale could be included to represent the anchors for the third factor and the positions of the various groups on it. Ellipses for successive values of the third factor would appear somewhat like a series of slices from a hard-boiled egg. Instances in which more than three factors would be required to represent criterion group discrimination would appear to be quite rare, judging from the results of discriminant analyses reported in the literature.

The discussion so far has involved only one of two general approaches to the calculation of similarity scores. The centour score approach gives an independent estimate of similarity to each of the criterion groups under consideration. A second approach, one that is based on the maximum likelihood principle, provides probabilities that take into account the relative degree of a counselee's similarity to each of the criterion groups (Cooley & Lohnes, 1962). The resulting similarity scores are given as decimal probabilities that sum to 1.00. Thus, if five criterion groups of equal size were involved in a validity study and a counselee were equally similar to all five, his similarity scores via the maximum likelihood technique would be .20 for each group. This would be true whether his similarity scores obtained via the centour method were all 99 or all 14. That is, relative degree of similarity rather than absolute amount is involved.

As another example, suppose that a counselee had factor scores of 70 and 25 on Factors 1 and 2, respectively, in Figure 1. Through use of the maximum likelihood technique, he would receive a very high similarity score for area E, possibly even higher than Fred Cartesian's score. This would occur because the counselee's similarity to students in area E is much greater than his similarity to students in the other

areas. However, it is obvious that the actual degree of similarity is quite low. Since a counselor would undoubtedly want to know this, the value of maximum likelihood procedures for educational and vocational guidance would appear to be quite limited. (Use of maximum likelihood procedures also limits the guidance applications of Tatsuoka's joint similarity-success index.)

If, on the other hand, one is interested in allocating individuals to treatment groups so as to achieve some overall goal of efficiency or correct placement, the maximum likelihood procedure would be an appropriate technique to use. When differences in criterion group size and dispersion are taken into account, the predictions based on maximum likelihood procedures maximize the classification accuracy achievable by the predictor variables (Cooley & Lohnes, 1962).

Recapitulation

The following eight points have been emphasized in the foregoing discussion of objective techniques for data-information conversion:

1. Information from tests, when viewed in the context of decision theory, can play an important role in educational and vocational development.

2. This role is primarily one of stimulating and facilitating exploratory behavior.

3. Two data-information conversion procedures--similarity scores and success estimates--are crucial to this role.

4. On the basis of both logical and technical considerations, similarity scores are more appropriate than success estimates in stimulating and facilitating exploratory behavior. Success estimates represent one of many things to be considered in the process of exploration.

5. Similarity scores eliminate much of the guesswork inherent in test profile interpretation.

6. Statistical and graphical procedures are available to facilitate understanding of the reasons underlying a given counselee's similarity scores, thus avoiding the take-it-or-leave-it aspects of test interpretation based on similarity scores alone.

7. These procedures can also facilitate use of test data to initiate changes in counselee characteristics and/or the characteristics of groups representing various choice options, rather than merely to represent the status quo.

8. Information conversion procedures must rely heavily on the availability of local validity data.

Implications for counselors

All of this is likely to be of little comfort to the conscientious counselor or personnel worker who has neither the time, training, nor inclination to become involved in data-related duties as versus people-related responsibilities. Few test users would disagree that there is a definite need to strengthen the bridges between test scores and their meaning for the counselee. But how is the job going to get done?

Two of the major stumbling blocks to conducting validity studies are data collection and analysis, fields in which great strides have been made in the last ten years through the use of computers. In addition to providing help with record keeping functions, computers have made time-consuming and/or highly sophisticated data analyses economically and psychologically feasible. Approaches to data-information conversion that have been available for some time are now possible on a large scale. This is probably nowhere better illustrated than in the work of Project TALENT staff members, in particular, Cooley and Lohnes (1968).

Drawing upon a nationwide sample of 400,000 high school students, each with scores on over 100 different measures, Cooley and Lohnes have provided structure to the framework of a computer-measurement system for guidance proposed several years earlier by Cooley (1964). The system consists of four basic components: (a) a comprehensive and readily accessible data bank containing information on the multiple characteristics of a pertinent sample obtained at the same stage of vocational development for which counseling information is needed; (b) a subsystem for collection of follow-up data showing the nature and results of various types of educational and career choices; (c) a subsystem for multivariate analysis of the relationships between the antecedent and follow-up data; and (d) techniques for converting the results of these analyses into information that is useful to the counselor in facilitating the educational and vocational development of his counselees.

The massive data base from which Project TALENT studies emanate should provide broad prospective on the career development process for many years to come. However, it is at the point of data-information conversion that Project TALENT studies have practical limitations. These limitations result from the multitude of measures involved and their unavailability to practitioners. Unless the test equating studies proposed by Cooley and Lohnes (1968) are eventually undertaken, it appears that counseling use of Project TALENT data will be limited to special programs such as Project PLAN (Flanagan, 1969).

The system illustrated by the Cooley-Lohnes studies is generalizable to other settings, however. Development of such systems and provision for wide access to them would appear to be essential to any major improvements in test interpretation procedures. If systems for data-information conversion were available at the local level, the need for the do-it-yourself prediction research described by Dyer could be met with little sacrifice of counselor time and mental equanimity. Much of the work required in data preparation could be completed by clerical help or one of the several types of guidance technicians proposed by Hoyt (1970).

The counselor's chief function would be to ask important questions of his data and to help his counselees use the resulting information. While data-information conversion systems will never replace professional knowledge, judgment, and experience, they can go a long way toward moving test interpretation out of the era of squint and tell.

Problem

The need and rationale for data-information conversion systems have been outlined above. Although originally only a secondary objective of the project, development and field testing of a prototype package of computer programs designed to facilitate data-information conversion gradually assumed major importance. In the approach that was used, heavy reliance was placed on the multivariate research and classification strategies represented by the work of Cooley and Lohnes (1962, 1968) and the decision-oriented paradigm for local guidance research proposed by Clarke, Gelatt, and Levine (1965). On the basis of research results and the experience gained through the use of the prototype system, specifications were developed for a generalized "Test Validation and Information Feedback System" (TVIFS) that would be applicable to divergent educational settings and a variety of data-information conversion needs. Support for the development of early phases of TVIFS was obtained from the Ohio Board of Regents. With the exception of the follow-up component, TVIFS is scheduled to become operational by September, 1970. Development of the follow-up component and system field testing is scheduled for the 1970-71 academic year. An overview of TVIFS is presented in Appendix A.

Project activities were conducted in an area vocational high school drawing students from 14 feeder schools. Several considerations made this an ideal setting in which to develop and implement data-information conversion procedures. For example, vocational programs are little known and often misunderstood by students, parents, and counselors. Nevertheless, students in the feeder schools must decide sometime during their sophomore or junior year whether they want to attend the area vocational school, and if so, which of some 25 vocational education programs they wish to enter. Informed choice is crucial since the vocational school attempts to honor the requests of its applicants instead of applying arbitrary placement procedures. Because of the concentrated amount of time spent in the programs (six out of eight periods a day), the choice a student makes may have a substantial effect on his vocational development. Student program choices are also of interest to vocational instructors and supervisors since the success of their programs depends on having students with the requisite abilities, interests, and motivation. In this context, data-information conversion procedures that call to a student's attention the vocational education programs for which he appears to have the requisite characteristics, can play an important role in improving the quality of enrollees in the various programs. At the same time, the student's freedom of choice is preserved, and the process of choice is facilitated.

Data-information conversion procedures require the presence of certain relationships between the antecedent and outcome variables. There is ample evidence that these relationships exist in vocational-technical school settings. Patterson (1956); Prediger, Waple, and Nusbaum (1968), and Stock and Pratzner (1969) have reviewed studies in which the correlation between antecedent variables and success criteria was determined. In general, these reviews have shown that (a) success in vocational education programs (usually measured by grades) is predictable to an extent that has practical significance; (b) the level of predictability

depends on the vocational area and the predictors that are used; and (c) the results of studies vary widely from one setting to another. These findings support the feasibility and desirability of developing success estimates based on local validity data.

Research in which multivariate procedures were used to study vocational program differences is finally beginning to accumulate. D'Costa (1968), Doerr and Ferguson (1968), Passmore (1968), Silver (1967), and Stewart (1966, 1968) have shown that students enrolled in various vocational programs can be differentiated to a statistically significant extent by aptitude, interest, and personality variables used alone or in various combinations. In each case, multiple discriminant analysis procedures were employed to study the way in which the groups were differentiated. Without exception, the first two discriminant factors accounted for most (typically more than 80%) of the discriminating power of the variables. Since the nature of the predictor variables and criterion groups varied from study to study, general conclusions as to the composition of the discriminating factors or the manner in which the groups differed are not possible. Comparison and generalization across studies will continue to be difficult until some agreement is reached on bench-mark variables and criterion groups. Passmore (1968) has shown that even when the same variables and groups are involved, validity generalization cannot be assumed.

In several studies, the accuracy of program membership predictions based on a student's similarity scores was determined. The level of accuracy achieved from study to study varied with the nature of the variables, the number of vocational programs involved, and the statistical procedures used in obtaining the predictions. Only Silver (1967) concluded that accuracy of the predictions did not warrant guidance applications. Use of similarity scores in counseling was suggested in several of the studies.

Longitudinal validation procedures were employed in only two of the seven studies cited above (Pucel, 1969; Silver, 1967). Thus, most of the evidence that vocational programs can be differentiated is based on predictor and criterion data collected concurrently. No one has reported the actual use of analysis results in an ongoing guidance program. In the present study, the results of longitudinal analyses provided the basis for converting data on students into information that was used by counselors in 12 field-test schools. Student and counselor reactions to this experience are reported.

As noted above, previous research has shown that the relationships between antecedent and outcome variables required for data-information conversion are likely to vary from one vocational education setting to another. Hence, the nature of these relationships must be determined for the setting in which data-information conversion procedures are to be used. For this reason, answers to the following questions were sought during the course of the project.

Similarity scores

1. What procedures are appropriate for identifying and grouping similar vocational programs when the objective is to facilitate data-information conversion?

2. Is it possible to differentiate successful and satisfied students enrolled in these programs through use of comprehensive batteries of aptitude, interest, or personality measures obtained prior to or shortly after entry into the programs? If so,

3. Which variables are most effective, and what is the nature of the group differentiation that is achieved?

Success estimates

4. Within each of the vocational program areas, considered separately, which of the aptitude measures has the highest correlation with success?

5. Are guidance applications of the best two-variable combination of predictors warranted on the basis of the level of correlation achieved and the contribution made by each predictor?

Although the answers to the above questions are specific to the setting in which the study was conducted, the techniques are directly transferable to other settings. For example, the same questions could be asked of data obtained from students prior to entry into various college majors or occupational clusters.

The primary objective of the project, as stated on page 9 of the project proposal, is restated as Research Question 2 above. Other items listed on page 9 and 10 of the project proposal are covered by Research Questions 1-5 and by the secondary objective of the project as restated at the beginning of this section. The need to reorder project objectives, while at the same time retaining original identity, became evident as work on the prototype data-information conversion system progressed.

Procedures

Subjects

The students in this study were enrolled at the Penta-County Vocational School, a vocational high school serving a five-county area surrounding Toledo, Ohio. When the project was begun early in 1966, 17 high schools sent students to Penta-County. As a result of consolidations, there were only 14 feeder high schools four years later. Enrollment in these schools varies from about 100 to 1,000 students with a median of about 500. The school districts range in socio-economic level and tax evaluation from low to above average and cover a composite of rural, small town, and urban areas, but not the center-city itself.

Penta-County operates approximately 24 different high-school-level vocational programs. (The number varies from year to year.) Most students enter as juniors; however, there are a few one-year programs open to seniors. The school has diligently tried to maintain an open-door policy that admits a student to the program of his choice. In cases where a large number of students apply for a program with limited space, this is sometimes impossible. However, every effort is then made to place the student in his second-choice program. Ramsey (1966) has presented a detailed description of the school, including the technical college with which it shares facilities.

Students entering Penta-County as juniors or seniors in the fall of 1966, 1967, and 1968 formed the sample used in the analyses. Since there is some shifting in and out of programs during the first month of school, sample membership was not determined until the end of September. The total sample consisted of 1,584 students, or approximately 500 students per year.

Variables

Scores from the following tests and inventories were used as antecedent variables:

1. General Aptitude Test Battery, Form B-1002, (GATB): Verbal Aptitude (V), Numerical Aptitude (N), Spatial Aptitude (S), Form Perception (P), Clerical Perception (Q), Motor Coordination (K), Finger Dexterity (F), and Manual Dexterity (M).

2. Differential Aptitude Tests, Form A, (DAT): Mechanical Reasoning subtest (MR).

3. Kuder Preference Record--Vocational, Form C, (Kuder) covering the following interest areas: outdoor (O-I), mechanical (M-I), computational (C-I), scientific (S-I), persuasive (P-I), artistic (A-I), literary (L-I), musical (MU-I), social service (SS-I), and clerical (CL-I).

4. Lorge-Thorndike Intelligence Tests, Form A: Verbal IQ (VIQ) and Nonverbal IQ (NVIQ).

5. Junior-Senior High School Personality Questionnaire, 1963 Edition, Form A, (HSPQ) covering the following personality dimensions: warmhearted (A-P), bright (B-P), emotionally stable (C-P), excitable (D-P), assertive (E-P), enthusiastic (F-P), conscientious (G-P), adventurous (H-P), tender-minded (I-P), reflective (J-P), apprehensive (O-P), self-sufficient (Q2-P), controlled (Q3-P), and tense (Q4-P).

Only the descriptive labels associated with high scores on the HSPQ are given for the above dimensions. Abbreviations for the HSPQ scales are identical to those appearing in the latest test manual (Cattell & Cattell, 1969). Since several Kuder and HSPQ scales are subject to rather substantial sex differences, normalized standard scores based on percentile ranks were used in the analyses. Students having verification scores of less than 33 were not included in the analyses of Kuder results. Range checks were made on the scores from all measures.

One additional antecedent variable, student GPA prior to entering Penta-County (PRE-GPA), was also available. Typically, information on students entering Penta-County as juniors included feeder school grades received during the freshman year and the first semester of the sophomore year. Grades for an additional year were available for students entering Penta-County as seniors.

There were 36 antecedent variables, altogether, with aptitude represented by 12 measures (8 GATB scores, MR, VIQ, NVIQ, and PRE-GPA), interests represented by the 10 Kuder measures, and personality characteristics represented by the 14 HSPQ dimensions. Except for the Lorge-Thorndike VIQ and the HSPQ, which were administered shortly after students entered Penta-County, the tests were generally given during the fall of the year preceding a student's entrance. The actual time of testing was left to the discretion of feeder school counselors. In all cases, testing was completed by midwinter. Several schools elected to give the tests in the spring of the year preceding a student's application to Penta-County. This would be slightly less than a year and one-half before entrance. Make-up testing involving approximately 15% of the sample was completed in the fall following entrance.

Design

In order to make the analyses, reports of results, and the interpretation of these reports more manageable, an answer to Research Question 1 was required; that is, a practical procedure for grouping the 24 vocational programs had to be found. Empirical procedures were considered, especially the Mahalanobis' D^2 technique (Rao, 1952); however, use of the results of the analyses in a counseling setting made a logical grouping seem more appropriate. The basic rationale was to obtain groups having face validity and utility for counselors and students rather than to maximize vocational program discrimination.

The Penta-County counseling staff and vocational supervisors participated in the initial grouping of the 24 vocational programs. Similarities in program content and student characteristics thought to be required in the programs served as the subjective criteria. The initial grouping was

used in preliminary discriminant analyses run on data available for 1966 and 1967 entrants. Slight revisions were made on the basis of group distribution in discriminant space and counselor reaction to similarity scores provided for a 1968-69 field-test sample. The revised grouping was subjected to a second discriminant analysis when data for the total sample became available. Additional counselor reaction, group size considerations, and the results of these analyses were used to arrive at the final grouping shown in Table 1.

Seven of the 12 groups are the same as they were in the initial grouping. Changes usually involved shifting a program from one group to another. For example, machine trades and welding switched places, and high skill steno became a separate area, having been initially combined with the cooperative office education and office machine programs.

The regression analyses required to answer Research Questions 4 and 5 were run separately for each of the 12 groups. However, answers to Research Questions 2 and 3 required that analyses be conducted <u>across</u> the various vocational programs. If the analyses were performed on all 12 groups simultaneously, sex differences from program to program would likely cloud information on program differences available in the antecedent variables. For example, one might find that programs enrolling girls can be differentiated from those enrolling boys on the basis of interests, aptitudes, and personality measures. This would be of little practical value, however, since there are better ways to tell girls from boys. Use of the results of the analyses for data-information conversion would also be limited since it makes little sense to report a girl's similarity to auto mechanics students or to report a boy's similarity to students in the high skill steno program. Such reports would most likely be meaningless from a statistical as well as a practical standpoint.

In order to avoid the problem noted above and at the same time provide for comprehensive analyses, the vocational programs were organized into three sex-related groups: programs enrolling primarily males, programs enrolling primarily females, and programs having a substantial enrollment of both males and females. As shown in Table 1, the male, female, and mixed groups each included four programs when the final analyses were performed. Separate analyses were run on the male and mixed groups combined (the M-MF analysis group) and the female and mixed groups combined (the F-MF analysis group). Thus, the M-MF and F-MF analysis groups each included eight vocational program groups. Similarity score reports were also based on this grouping.

Multivariate analyses of variance and discriminant analyses were used to study the differentiation of students enrolled in the vocational programs. These analyses were first run separately on each of the three types of antecedent variables. Ten of the most effective variables identified in these analyses were then combined in the final analysis on which the similarity score equations were based.

The vocational programs used in the discriminant analyses did not include students who dropped out of school or returned to the feeder high school, who expressed dissatisfaction with program choice, or who failed

Table 1

Final Grouping of Vocational Program Areas

Vocational area	Original sample	Discriminant analyses[a]		Regression analyses
		Eligible	Data available	
Programs primarily enrolling males				
A. Carpentry	57	48	41	52
B. Auto & Ag. Mech., machine trades	242	163	139	225
C. Radio & TV repair, electronics	88	58	54	82
D. Auto body, welding	116	88	73	108
Total	503	357	307	467
Programs enrolling both males and females				
E. Horticulture	50	29	24	41
F. Distributive Educ.	103	51	38	79
G. Commercial art, printing, drafting	204	150	134	185
H. Data processing, account clerk	126	93	86	113
Total	483	323	282	418
Programs primarily enrolling females				
I. Child care, Comm. & home Serv., dietary aid	162	95	87	128
J. Cosmetology, dental Asst.	199	151	132	171
K. Co-op. office Educ., office machines	154	116	102	124
L. High skill steno	83	66	61	61
Total	598	428	382	484
Total sample	1584	1108	971	1369
M-MF analysis group	986	680	589	885
F-MF analysis group	1081	751	664	902

[a]Sample sizes shown here are for the final analyses conducted on aptitude and interest measures, combined. Sample sizes for the separate analyses performed on the aptitude, interest, and personality variables are given in Table 2.

to achieve a satisfactory GPA in their vocational course work. The cut-off point for a satisfactory GPA was 1.8 or better with a "C" being 2.0 on a 4.0 scale. Academic course work was not included in calculating a student's GPA.

A survey of student satisfaction with program choice was taken at the end of the 1968-69 school year. Hence, results were available for juniors entering Penta-County in 1967 and juniors and seniors entering in 1968. Unfortunately, a post high school follow-up of 1966 entrants and the small group of seniors entering Penta-County in 1967 was not completed in time to include their satisfaction ratings in the definition of the criterion groups. Satisfaction ratings were available for about two thirds of the sample, however.

The ratings were obtained on a four-choice scale administered under conditions conducive to confidentiality of response. Students indicating that other vocational programs would definitely have been more appropriate to their abilities and interests or who expressed a more intense degree of dissatisfaction with the program in which they were enrolled were not included in the criterion groups. About 12% of the students who were surveyed were excluded for this reason.

The number of students available in each of the program groups after application of the success and satisfaction criteria is shown in the column labeled "eligible" in Table 1. Despite extensive make-up testing, not all of these students had a complete set of scores. The "data available" column of Table 1 shows the number of eligible students who had scores on the ten aptitude and interest measures used in the final discriminant analyses.

Students involved in the regression analyses did not have to meet the criteria of eligibility applied to the discriminant analysis groups. Vocational program GPA at time of graduation or drop-out was used as the criterion of success. Hence, only students who left school before they had established a grade record or who had missing test scores were excluded from the regression analyses. The number of students in the regression analyses groups is shown in Table 1.

Results and Conclusions

Conclusions reached with respect to the project objectives and research questions are stated in the context of the results supporting these conclusions. Because of the importance assumed by the data-information conversion procedures as the project progressed, these procedures and the field tests of them are given special attention in this section.

Modified versions of the Cooley-Lohnes computer programs (Cooley & Lohnes, 1962) were used for the multivariate analyses of variance and discriminant analyses required to answer Research Questions 2 and 3. These programs include Box's F test for homogeneity of group dispersions, Wilk's lambda test for overall group differentiation, and Rao's chi square test for group differentiation by a single discriminant function or factor.

The significance levels indicated by the statistical analyses were used in assessing the role that chance might have played in producing the observed results. Interest was primarily in data reduction and information feedback rather than the discovery of general laws of nature. Decisions with respect to data-information conversion strategies were based, in part, on the results of the significance tests and, in part, on other information produced by the statistical analyses.

Question 1

Workable procedures for identifying and grouping similar vocational programs were described in the design section of this report. Essentially, these procedures rely on the pooled judgment of counselors and vocational supervisors acquainted with the nature of the programs and students to be grouped. Major consideration is given to forming program clusters that will be helpful to students who are considering vocational program choice options. Empirical data on the characteristics of group members are used, along with counselor reactions based on field tests, to make adjustments in original group composition. Few adjustments were found to be necessary in the setting in which these procedures were implemented. Counselors expressed no dissatisfaction with the vocational program grouping used during the 1969-70 field tests. Hence, it may be concluded that the procedures are appropriate for identifying and grouping similar vocational programs when the objective is to facilitate data-information conversion.

Question 2

Eight vocational program groups were involved in the personality measure analyses. Nine groups were involved in the separate aptitude and interest measure analyses in order to obtain empirical information for use in grouping similar vocational programs. Group labels and sample sizes are shown in Table 2.

The F values obtained from Box's test for homogeneity of dispersions were uniformly small across all analyses. The median value was 1.11 with the range being 1.01 to 1.18. The size of these F values would not appear

Table 2

Vocational Program Areas Used in Separate Analyses of Aptitude, Interest, and Personality Measures

Vocational area		Sample size[a]		
		Aptitude	Interest	Personality
Programs primarily enrolling males				
A.	Carpentry	42	41	45
B1.	Auto & Ag. mechanics	114	104	161[b]
B2.	Machine trades	37	36	
C.	Radio & TV repair, electronics	52	56	55
D.	Auto body, welding	81	75	77
Total		326	312	338
Programs enrolling both males and females				
E.	Horticulture	24	24	26
F.	Distributive Educ.	31	39	44
G.	Commercial art, printing, drafting	135	137	146
H.	Data processing, account clerk	80	89	90
Total		270	289	306
Programs primarily enrolling females				
I1.	Child care	36	41	91[c]
I2.	Community & home serv., dietary aid	46	47	
J.	Cosmetology, dental assistant	133	136	130
K.	Co-op. office Educ., office machines	79	107	97
L.	High skill steno	49	62	53
Total		343	393	371
Total sample		939	994	1015
M-MF analysis group		596	601	644
F-MF analysis group		613	682	677

[a]Includes only those students meeting the success and satistaction criteria and who had data available.

[b]Areas B1 and B2 were combined in the HSPQ analyses.

[c]Areas I1 and I2 were combined in the HSPQ analyses.

to invalidate Wilks' lambda test for group differentiation. As noted by Cooley and Lohnes (1962), Wilks' test is relatively insensitive to slight departures from homogeneity of dispersion.

Results from Wilks' lambda test are presented in Table 3. All F values obtained via the multivariate analyses of variance are statistically significant at far beyond the .01 level. Thus, in answer to Research Question 2, vocational program differentiation is possible through use of aptitude, interest, or personality measures.

Perspective on the relative effectiveness of the different types of measures can be obtained by comparing the F values. For example, the interest measures appear to be somewhat more effective than the aptitude measures in the M-MF analysis group, but about equally effective in the F-MF group. The personality measures were, by far, the least effective of the three types. Since the number of groups used in the analyses differed, a strict comparison of F values obtained with the personality measures as versus the aptitude and interest measures is not warranted. However, multivariate analyses of variance involving 9 of the 12 aptitude measures across the same 8 groups used with the personality measures, resulted in F values of 4.34 and 7.48 for the M-MF and F-MF analysis groups, respectively. Both of these values are much larger than those obtained through use of the personality measures.

Because of their relatively poor showing in the separate analyses, the personality measures were eliminated from the final analyses. Only the most effective aptitude and interest measures, as judged on the basis of separate discriminant analyses, were included. Multivariate analyses of variance involving ten of these aptitude and interest measures in combination, resulted in F values of 9.10 and 11.83 for the M-MF and F-MF analysis groups, respectively. Since these values are much larger than those obtained for the aptitude and interest measures separately, it would appear that use of both types of measures, in conjunction, results in substantially more group differentiation than use of either, alone. A cross-validation sample is needed to provide conclusive evidence on this point, however.

Question 3

As already noted, discriminant analyses were performed in conjunction with each of the analyses discussed above. The statistical significance and relative effectiveness of the discriminant factors obtained in the discriminant analyses are reported in Table 4. The first two factors achieved significance at far beyond the .01 level. The significance tests for the aptitude and interest measures combined must be discounted, however, because a cross-validation sample was not used. Nevertheless, the size of the chi square values provides substantial evidence that the vocational program groups can be differentiated on a number of dimensions. The interest measures appeared to be particularly effective in this respect.

By noting the size of the chi square values obtained in the significance tests for a given set of predictors, it is possible to gain perspective on the relative effectiveness of the factors. Inspection of these

Table 3

Results of Wilks' Lambda Test

for Group Differentiation

Type of measure	No. of groups	No. of variables	Analysis group: M-MF F	M-MF d.f.	F-MF F	F-MF d.f.
Aptitude	9	12	3.86	96&3890	6.14	96&4005
Interest	9	10	5.98	80&3706	6.28	80&4220
Personality characteristics	8	14	1.77	98&3949	2.07	98&4158

Note.--An F value of 1.44 is needed for significance at the .01 level for 75 and 1000 degrees of freedom.

Table 4

Chi Squares Indicating Relative Differentiation of Groups by Discriminant Factors

	Type of measure							
	Aptitude		Interest		Personality		Aptitude & interest	
Factor	M-MF	F-MF	M-MF	F-MF	M-MF	F-MF	M-MF	F-MF
1	191.5***	255.6***	154.7***	200.7***	75.8***	83.7***	257.0***	346.8***
2	98.3***	192.4***	132.0***	122.5***	35.3**	43.8***	147.6***	231.6***
3	23.7	44.9***	95.3***	56.6***	22.0	25.4	99.3***	74.3***
4	19.7	26.9*	36.8***	54.4***	17.2	18.6	49.7***	52.1***
5	12.8	15.3	20.8*	28.8***	11.6	17.5	22.9**	35.3***
6	8.9	12.2	13.2	10.7	6.5	8.8	10.4	13.2*
7	2.1	6.8	1.7	4.9	3.4	2.7	3.0	3.2
8[a]	1.7	3.2	1.2	1.1				

[a]Since only eight groups were involved in the analyses for the personality variables and the aptitude and interest measures combined, seven factors exhausted the discriminating power of the measures.

***$p < .001$, **$p < .01$, *$p < .05$

values shows that a large majority of the discriminating power of the measures was generally concentrated in the first two factors. Attention is focused on the first two factors in the results presented below.

Tables 5 through 8 show the correlation of the first two factors with the variables used in each of the analyses. The same information for Factors 3 and 4 is presented in Tables 11 through 14 in Appendix D. Vocational program means on the first four factors are presented in Tables 15 through 18 of the same appendix. The ten measures selected for the combined aptitude-interest analyses are listed in Table 8. Sample sizes appeared to be too small to warrant use of all 22 aptitude and interest measures in the final analyses. Unfortunately, specific guidelines have not yet appeared on the minimum number of cases per variable per group required for discriminant analysis.

The nature of the factors that best serve to differentiate students in the various vocational programs and the manner in which these programs are differentiated can best be seen from the similarity score profiles presented as Figures 2 through 9. These profiles each represent a concise answer to Research Question 3. In Figures 2 through 7, the positions of the vocational program means (centroids) on the first two factors have been plotted as single points. In Figures 8 and 9, group position on the two factors is also shown by an ellipse enclosing the scores of about 50% of the group members. The ellipses provide excellent perspective on the amount of group differentiation achieved.

Figure 9 is shown in the same form in which it was used by counselors during field testing of data-information conversion procedures. Figure 8 illustrates several improvements resulting from counselor reactions based on the field-test form. For example, there is better color differentiation in the ellipses; the vocational programs have been labeled; and the approximate correlation of the anchor variables with the factors has been indicated for variables having a correlation with an absolute value of .40 or higher.

Figure 2 will be used as an example of how similarity score profiles can provide information relevant to Research Question 3. Note that the first factor dimension is characterized by academic- and clerical-related aptitudes versus mechanical reasoning aptitude. Program differentiation on this factor is evident from the distribution of the groups along the standard score scale. For example, the data processing and account clerk students (area H) score toward the academic-clerical end of the dimension, and as one would also expect, auto-Ag. mechanics, welding, and auto body students (areas B1 and D) score toward the mechanical end. The second factor appears to represent a mechanical-technical dimension with radio-TV repair, electronics, and machine trades students (areas C and B2) obtaining the highest scores on the factor. Horticulture and distributive education students (areas E and F) score toward the other end of the dimension, as one would expect. More than one and one-half standard deviations separate the extreme groups on both factors. Thus, the major aptitude dimensions differentiating students enrolled in the nine vocational programs represented by the M-MF analysis group appear to be an academic-clerical versus mechanical reasoning dimension and a mechanical-technical dimension. Similar analysis procedures can be applied to the other profiles.

Table 5

Aptitude Variable Correlations with

First Two Factors

Variable	M-MF analysis group		F-MF analysis group	
	Factor 1	Factor 2	Factor 1	Factor 2
MR	-.42	.84	-.28	.87
V	.48	.33	.51	.36
N	.49	.35	.59	.29
S	.03	.59	-.01	.50
P	.31	.17	.39	-.02
Q	.52	.19	.56	-.11
K	.25	.04	.53	-.12
F	.25	-.09	.41	-.16
M	.00	.19	.29	.04
PRE-GPA	.67	.41	.77	.48
VIQ	.58	.46	.46	.57
NVIQ	.32	.57	.26	.70

Table 6

Interest Variable Correlations with

First Two Factors

	M-MF analysis group		F-MF analysis group	
Variable	Factor 1	Factor 2	Factor 1	Factor 2
O-I	.63	.33	.28	.13
M-I	.72	-.09	.27	.13
C-I	-.50	-.54	-.48	-.01
S-I	.11	-.40	.01	.10
P-I	-.28	-.12	-.04	-.27
A-I	-.17	.84	.33	.77
L-I	-.15	.08	.01	.07
MU-I	.04	-.08	-.01	.26
SS-I	.07	-.01	.45	-.59
CL-I	-.67	-.42	-.93	-.12

Table 7

Personality Variable Correlations with

First Two Factors

Variable	M-MF analysis group		F-MF analysis group	
	Factor 1	Factor 2	Factor 1	Factor 2
A-P	-.13	-.21	.33	.13
B-P	.54	.15	.71	.25
C-P	-.16	-.05	.09	.23
D-P	-.07	-.04	-.29	-.26
E-P	-.28	-.12	-.09	-.13
F-P	-.21	.13	.21	.48
G-P	.32	-.02	.38	.06
H-P	-.17	.45	-.01	.48
I-P	-.01	.29	.05	.16
J-P	-.26	.58	-.28	.43
O-P	.11	-.03	-.16	-.19
Q2-P	-.60	-.10	-.47	.15
Q3-P	.15	-.01	.14	-.01
Q4-P	.05	.13	-.14	.08

Table 8

Correlations of Aptitude and Interest Variables Used in Final Analyses with First Two Factors

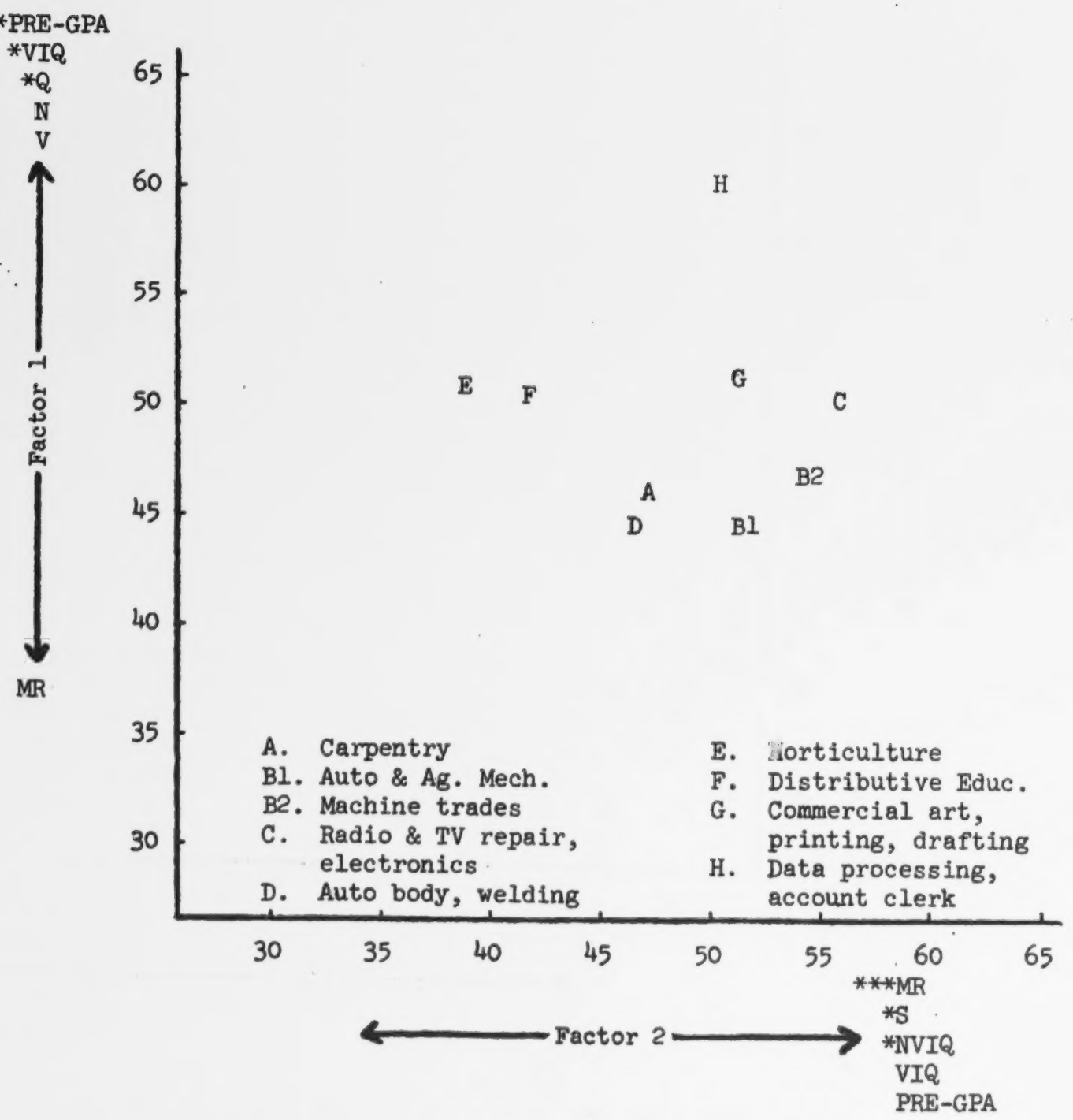
Variable	M-MF analysis group		F-MF analysis group	
	Factor 1	Factor 2	Factor 1	Factor 2
MR	.35	.58	-.02	.86
N			.64	.04
S	.01	.25	.07	.40
Q	-.45	.11	.38	-.32
PRE-GPA	-.55	.27	.79	.09
O-I	.50	-.22	-.24	.04
M-I	.54	.36		
C-I	-.51	.35	.37	.18
S-I	.02	.43		
A-I	.06	-.58	-.28	.44
SS-I			-.24	-.49
CL-I	-.63	.17	.70	.08

Note.--A vacant cell indicates that the associated variable was not used with the analysis group.

Figure 2

Distribution of M-MF Analysis Groups

on First Two Aptitude Factors

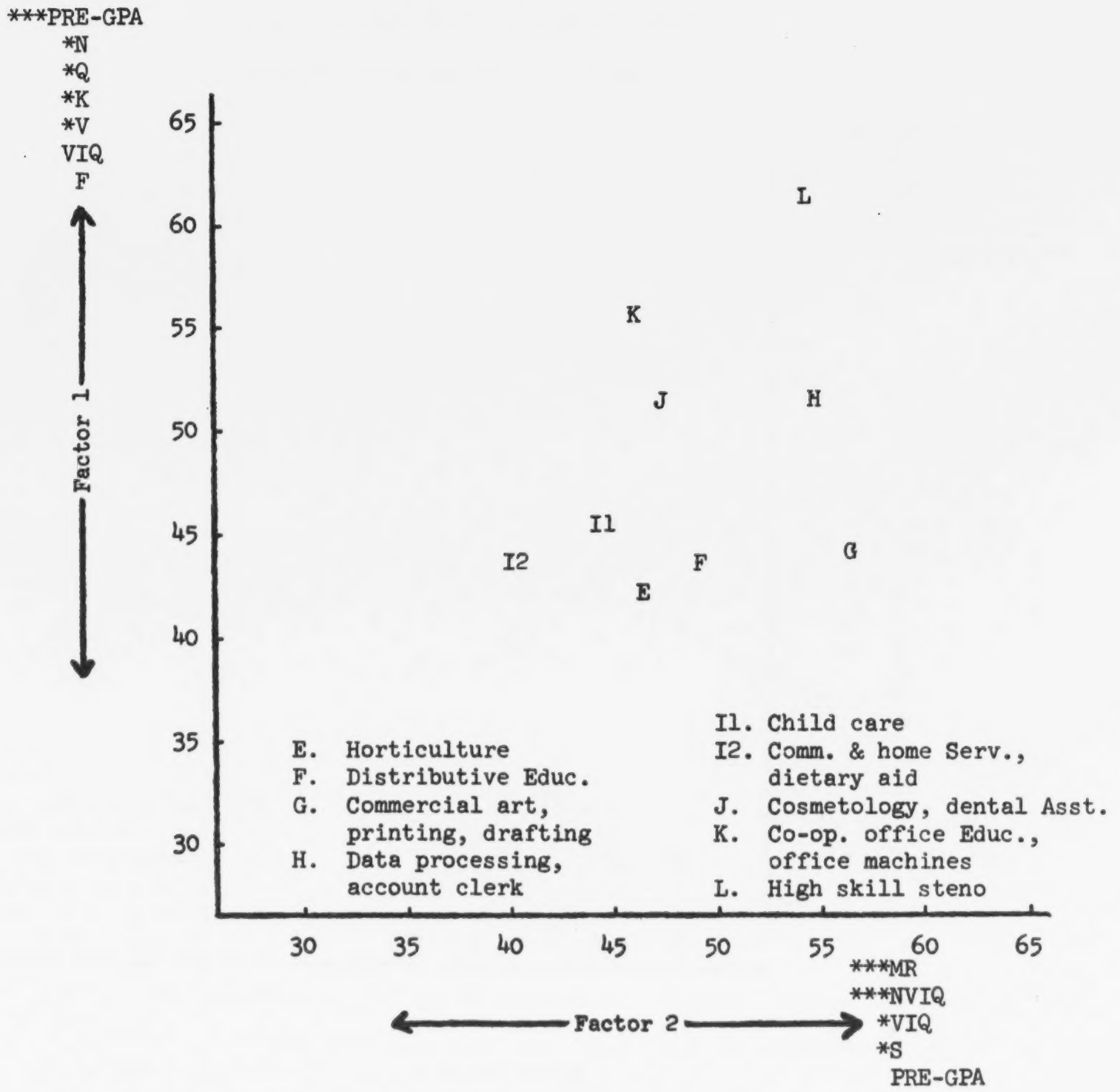


Note.--*** = r > .69; ** = r of .60-.69; * = r of .50-.59; no * = r of .40-.49. Variables having factor loadings with an absolute value of less than .40 are not listed as factor anchors.

Figure 3

Distribution of F-MF Analysis Groups

on First Two Aptitude Factors

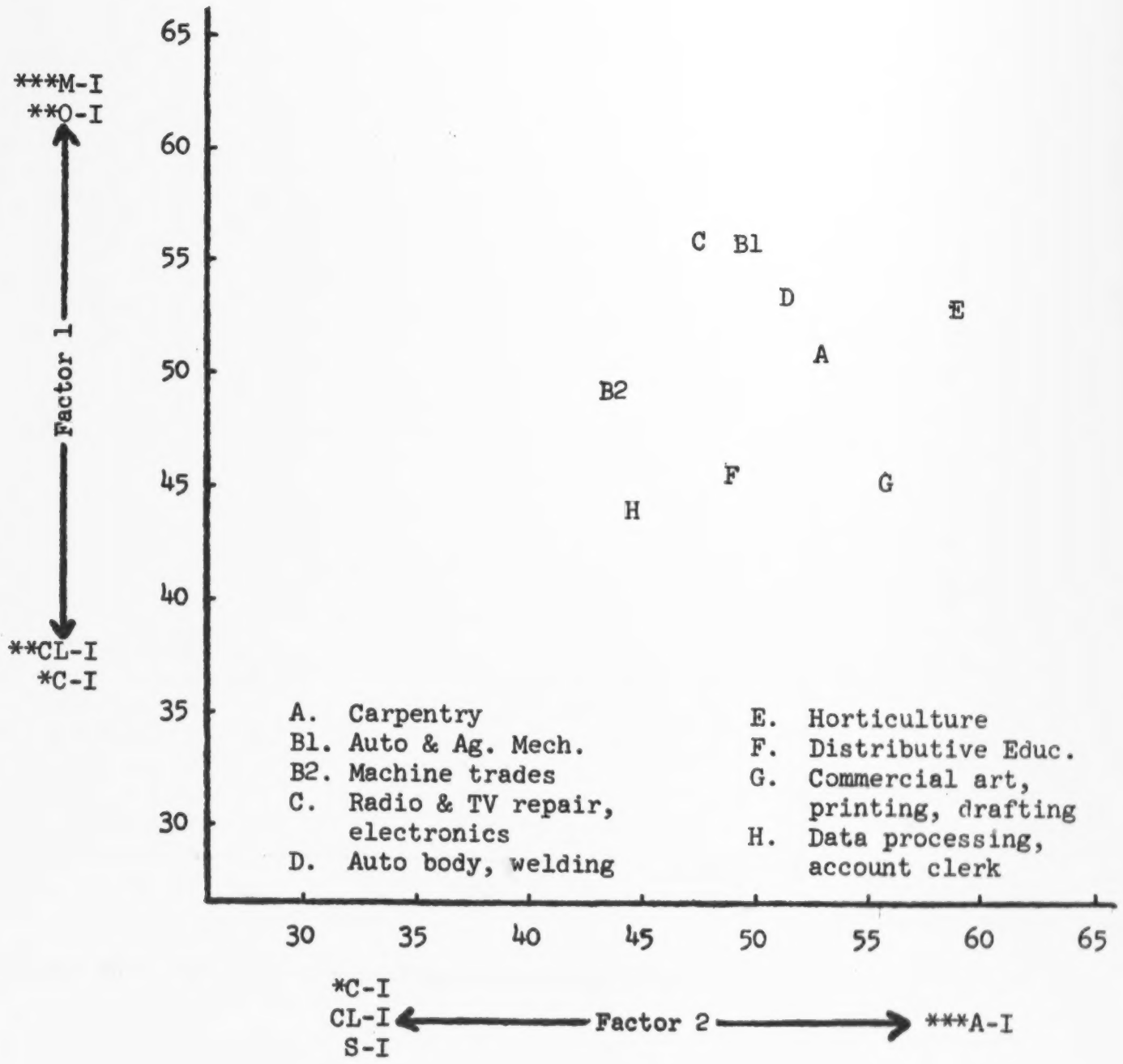


Note.--*** = r≥ .69; ** = r of .60-.69; * = r of .50-.59; no * = r of .40-.49. Variables having factor loadings with an absolute value of less than .40 are not listed as factor anchors.

Figure 4

Distribution of M-MF Analysis Groups

on First Two Interest Factors

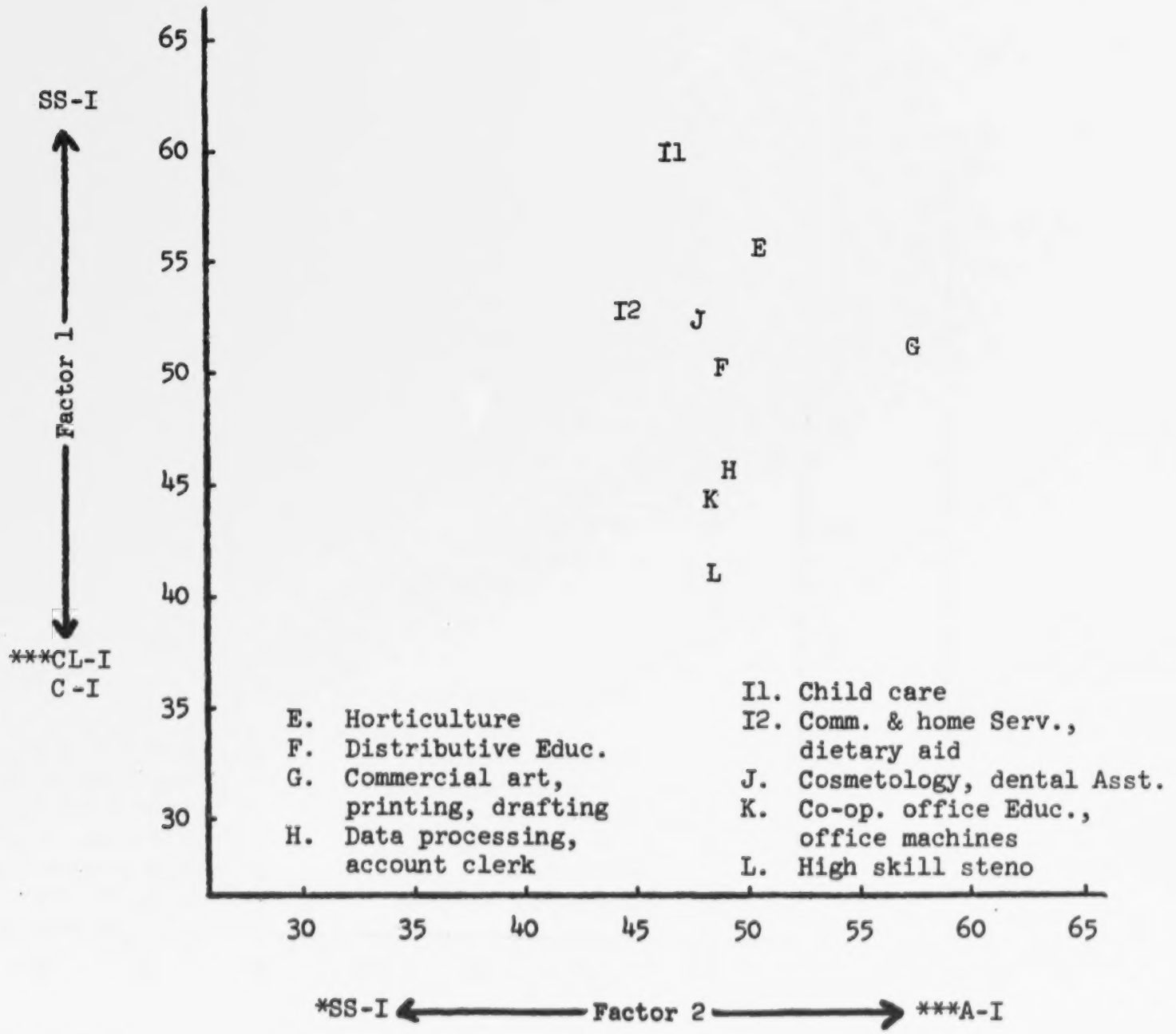


Note.--*** = r > .69; ** = r of .60-.69; * = r of .50-.59; no * = r of .40-.49. Variables having factor loadings with an absolute value of less than .40 are not listed as factor anchors.

Figure 5

Distribution of F-MF Analysis Groups

on First Two Interest Factors

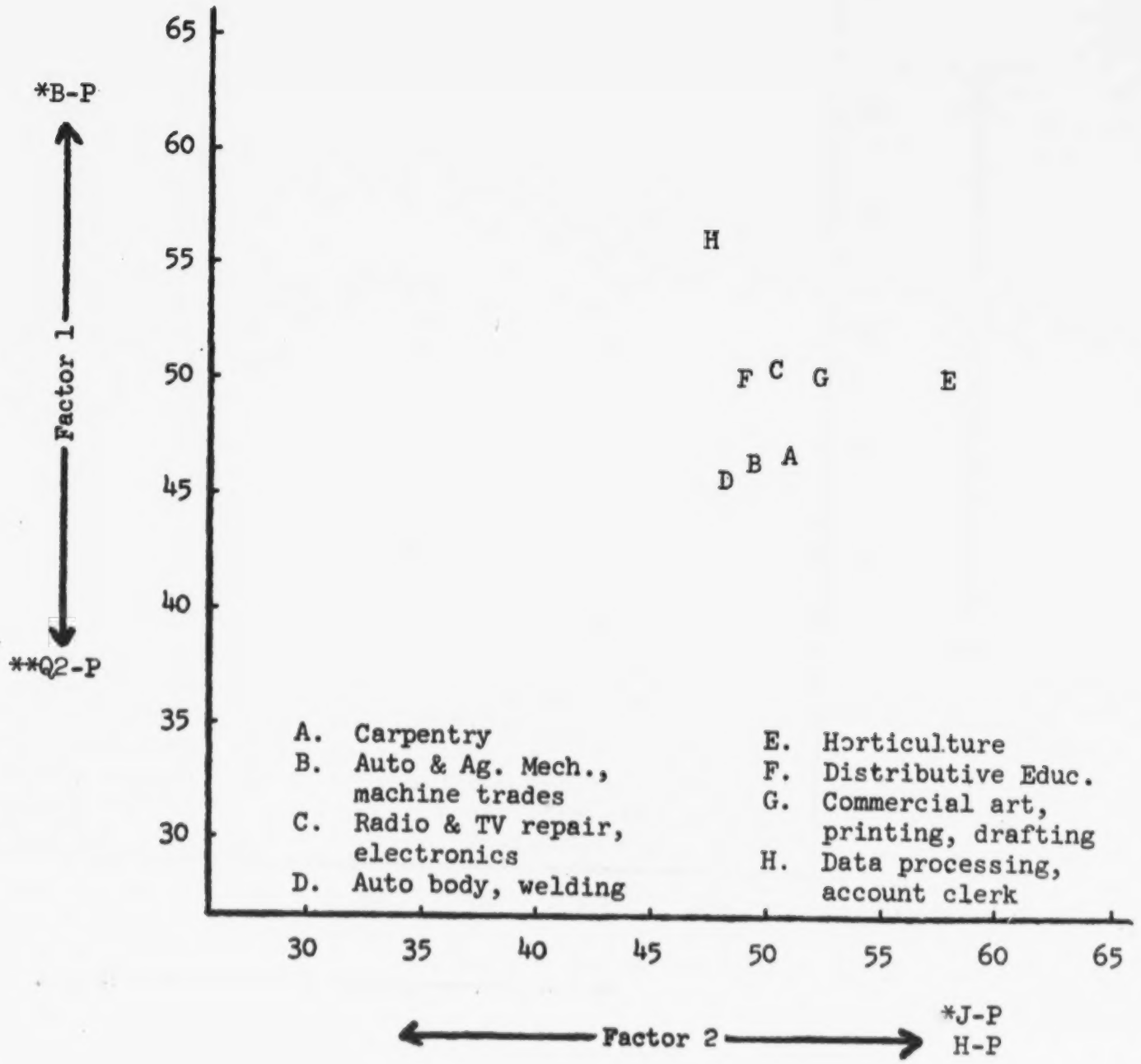


Note.--*** = r > .69; ** = r of .60-.69; * = r of .50-.59; no * = r of .40-.49. Variables having factor loadings with an absolute value of less than .40 are not listed as factor anchors.

Figure 6

Distribution of M-MF Analysis Groups

on First Two Personality Factors

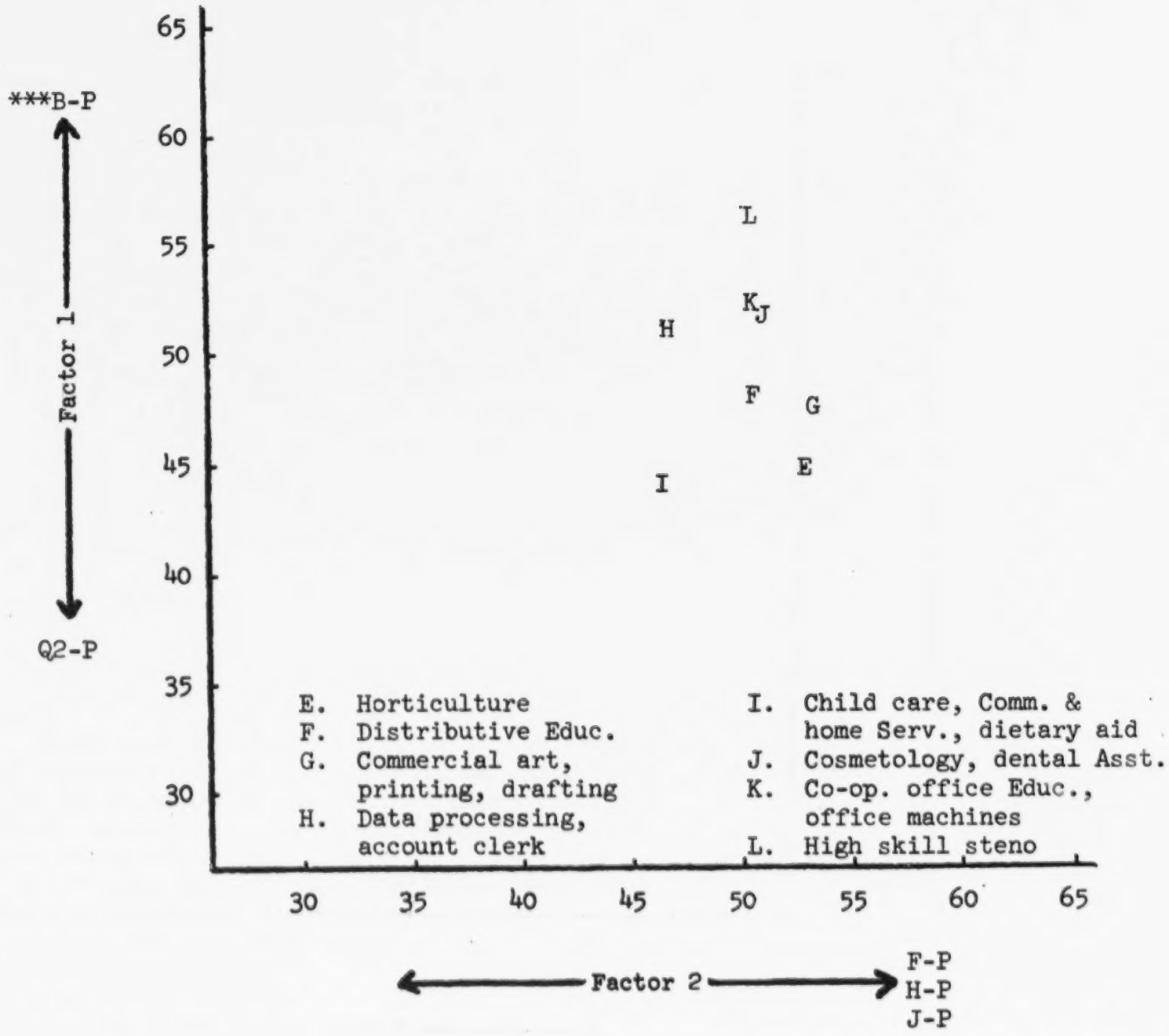


Note.--*** = r>.69; ** = r of .60-.69; * = r of .50-.59; no * = r of .40-.49. Variables having factor loadings with an absolute value of less than .40 are not listed as factor anchors.

Figure 7

Distribution of F-MF Analysis Groups

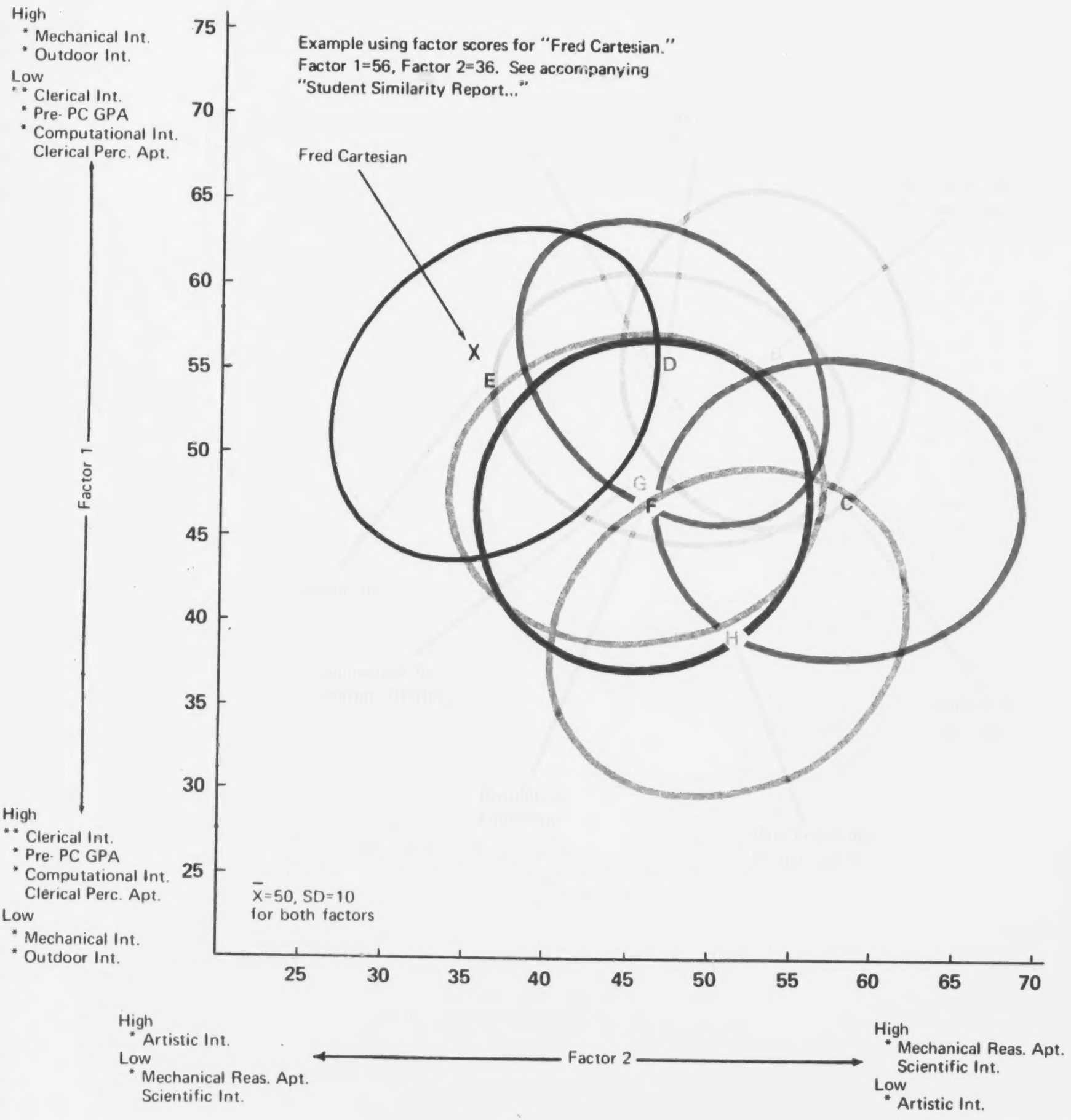
on First Two Personality Factors



Note.--*** = r > .69; ** = r of .60-.69; * = r of .50-.59; no * = r of .40-.49. Variables having factor loadings with an absolute value of less than .40 are not listed as factor anchors.

Figure 8

SIMILARITY SCORE PROFILES FOR PENTA-COUNTY VOCATIONAL AREAS
CHART IA: MALE AND MIXED GROUPS



This chart can be used to plot a student's factor scores in order to facilitate interpretation of the similarity scores given on the "Student Similarity Report..." The aptitude and interest dimensions represented by the factors are labeled at the ends of the factor scales. When ellipses are shown, they enclose about 50% of the factor scores of students falling in each of the indicated vocational areas. Correlation between variables and factors is indicated as follows:

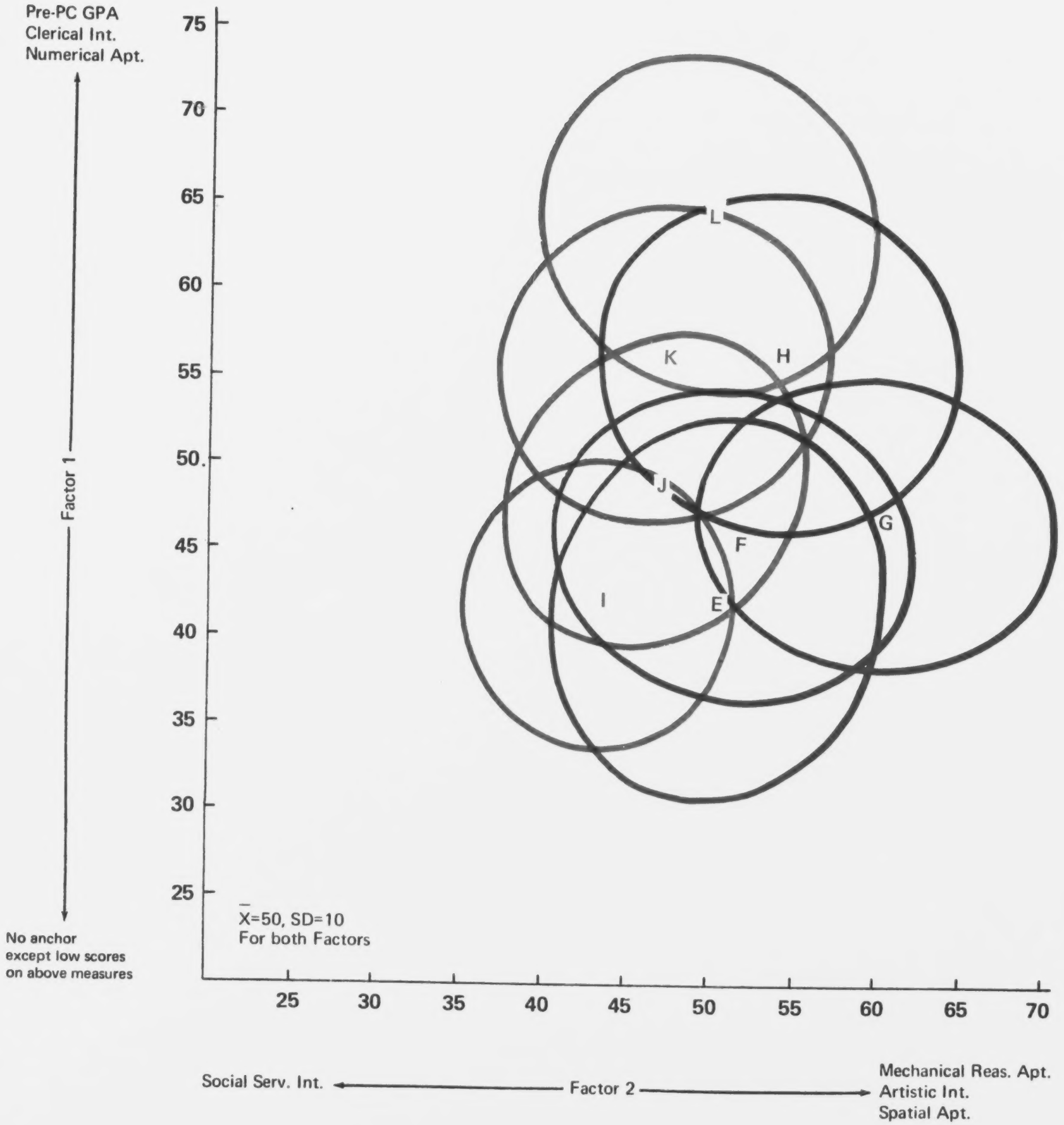
39

*** = r > .69; ** = r of .60 – .69; * = r of .50 – .59; no * = r of .40 – .49

Figure 9

CENTOUR SCORE PROFILES FOR PENTA-COUNTY VOCATIONAL AREAS

CHART IB: FEMALE AND MIXED GROUPS



The vocational areas represented by the letters on this chart are defined by the "Student Similarity Report for Penta-County Vocational Programs." About 50% of the factor scores of students falling in each of the indicated areas is enclosed by the ellipses. The aptitude and interest dimensions represented by the factors are labeled at the ends of the factor scales. This chart can be used to plot a student's factor scores in order to facilitate interpretation of the similarity scores given on the "Student Similarity Report..."

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Question 4

Regression analyses using the aptitude measures as predictors and vocational program GPA as the criterion of success were run for each of the 12 program groups. In these analyses, the GATB intelligence score (G) was added to the original predictors.

Zero-order correlations between the predictors and the criterion are given in Table 9. In answer to Research Question 4, PRE-GPA is, with only one exception, the best single predictor across the vocational program areas. The one exception involves VIQ and the vocational horticulture group. Depending on vocational area, a variety of other measures rank second in order of effectiveness.

Question 5

The best two-variable combination of predictors was determined for each vocational program group by means of multiple regression analyses. (The VIQ and NVIQ measures were not included in these analyses because the vocational school had decided to discontinue their use.) These combinations, along with the multiple correlation coefficients that were obtained, are shown in Table 10. The results for other combinations of predictors are also shown for sake of perspective. There is substantial evidence of differential predictability in the aptitude measures accompanying PRE-GPA in the two-variable combinations. In most cases, the measures involved make good sense. Very little predictive ability appears to be lost by using the best combination of two predictors rather than the best three.

In order to judge whether practical application of the best two-variable combination of predictors is warranted, two criteria were applied. First, each predictor in the best two-variable combination for a given vocational program group had to make a statistically significant contribution ($p < .05$) to the level of correlation achieved. This was judged by one-tailed *t*-tests on the Beta weights obtained for the variables. Two groups--carpentry, and auto body and welding--failed to achieve this criterion. The second criterion involved the amount of increase in correlation obtained through use of those variables meeting the first criterion. This increase had to be large enough to warrant use of both predictors rather than just the single best predictor. All predictor combinations meeting the first criterion were judged to have met the second. Thus, in answer to Research Question 5, practical application of two-variable predictor combinations is warranted in 10 of the 12 vocational program groups. Since application of the second criterion is purely a matter of judgment, the reader is urged to compare the correlations presented in Tables 9 and 10.

Data-information conversion

The results described above provide the potential Penta-County student with little help in the exploration of vocational program choice. The real pay-off of the statistical analyses does not come until the results are used to convert student data into counseling information.

Table 9

Correlations Between Aptitude Variables

and Vocational Course GPA

Vocational area	VIQ	NV-IQ	MR	General Aptitude Test Battery G	V	N	S	P	Q	K	F	M	PRE-GPA
A. Carpentry	05	-03	05	21	18	25	-01	-04	22	07	09	19	30
B. Auto & Ag. Mech., machine trades	19	17	27	19	07	19	25	15	09	07	05	06	37
C. Radio & TV repair, electronics	05	04	04	01	04	08	03	26	21	20	29	23	33
D. Auto body, welding	11	06	16	-02	-06	00	06	-08	00	-08	-03	05	38
E. Horticulture	60	16	-22	17	18	22	-07	26	17	29	33	42	55
F. Distributive Educ.	04	27	-04	08	09	15	01	21	26	18	10	03	38
G. Commercial art, printing, drafting	25	25	07	30	17	21	21	29	30	13	01	07	56
H. Data processing, account clerk	32	41	20	48	34	39	19	16	21	04	-01	04	52
I. Child care, Comm. & home Serv., dietary aid	28	30	24	28	21	19	27	18	07	-01	30	19	42
J. Cosmetology, dental assistant	24	21	-02	22	14	30	10	15	16	-01	22	08	47
K. Co-op. office Educ., office machines	38	26	29	49	54	39	20	22	24	30	18	22	56
L. High skill steno	50	44	11	43	35	41	14	13	10	12	-07	12	70

Note.--Decimals have been omitted from all correlation coefficients in order to conserve space.

Table 10

Multiple Correlations Between Aptitude Variables and Vocational Course GPA

Vocational area	Two-variable combinations[a]			Best three-variable combination[a]
	Best	2nd	3rd	
A. Carpentry	M(.36)	Q(.34)	N(.33)	Q&M(.38)
B. Auto & Ag. Mech., machine trades	MR(.44)	S(.42)	P(.38)	MR&V(.46)
C. Radio & TV repair, electronics	F(.41)	M(.40)	P(.38)	G&F(.45)
D. Auto body, welding	MR(.40)	V(.40)	P(.39)	MR&V(.43)
E. Horticulture	M(.60)	MR(.58)	F(.58)	MR&M(.64)
F. Distributive Educ.	Q(.45)	P(.42)	K(.40)	Q&F(.45)
G. Commercial art, printing, drafting	P(.58)	Q(.58)	M(.56)	P&Q(.58)
H. Data processing, account clerk	G(.58)	V(.56)	Q(.55)	G&Q(.59)
I. Child care, Comm. & home Serv., dietary aid	F(.47)	S(.45)	P(.45)	K&F(.48)
J. Cosmetology, dental assistent	F(.50)	N(.49)	Q(.48)	N&F(.51)
K. Co-op. office Educ., office machines	V(.65)	G(.63)	K(.61)	V&M(.67)
L. High skill steno	G(.73)	V(.72)	N(.72)	G&S(.74)

Note.--The multiple correlation coefficient appears in parentheses after the variable label.

[a]In each case, PRE-GPA was one of the variables.

In the case of success estimates, this is readily accomplished via experience tables.

Results of the regression analyses conducted to answer Research Questions 4 and 5 were used to select the variables for which single- and double-entry experience tables were constructed. These tables are presented in Appendix B in the form in which they were provided to the counselors during field tests. For most vocational program groups, PRE-GPA was by far the best predictor. Hence, all single-entry experience tables are based on this variable. The tables cover each of the 12 program groups even though the correlation for a given group sometimes indicated a negligible relationship. It seems desirable to provide the counselor and counselee with this information along with the tables for groups in which the relationship was substantial. However, double-entry tables were constructed for only those program groups in which a positive answer was obtained for Research Question 5.

Score categories in the experience tables were formed in such a manner as to divide the total number of students in a vocational program group into halves, thirds, or fourths--the number of categories depending on the number of students in the group. It was not always possible to set up intervals that included exactly 25%, 33 1/3%, etc., of the students in a group because tied scores at the category boundaries would have required allocating students with the same score to different categories.

Similarity scores, the second data-information conversion procedure used in the project, were based on the combination of ten aptitude and interest variables involved in the final discriminant analyses. Through application of centour score equations obtained from the M-MF and F-MF analysis groups, separate sets of similarity scores were developed for boys and girls. Each set contained scores for the eight areas appropriate to the student's sex. FORTRAN language computer programs, written as part of the project, were used to place the scores from the antecedent variables into a disk file established for each prospective Penta-County applicant. Commercially-available reports in the form of punched cards were obtained for all measures except the Lorge-Thorndike and the DAT-MR, which were scored locally. No similarity scores were generated for students having scores out of range or a Kuder verification score of less than 33.

A modification of the classification program written by Cooley and Lohnes (1962) was used to calculate the similarity scores. Reports were in the form of a computer-printed label pasted on a pre-printed interpretation sheet. A manual was prepared to assist counselors in the use of the reports. Important sections of this manual, including a "Student Similarity Report," for our fictitious friend, Fred Cartesian, are reproduced in Appendix B.

Similarity score labels and pre-printed interpretation sheets were sent to feeder school counselors as soon as all test score reports had been received and processed at an operations center established at the University of Toledo. Transfer of center responsibilities and computer programs to the Penta-County Vocational School is scheduled for completion by September, 1970. The vocational school district will continue project activities through use of its own funds and computer facilities.

Field tests

Initial field-testing of project data-information conversion procedures involved 160 sophomores enrolled in four feeder high schools during the 1968-69 school year. The counselors in these schools volunteered to use project reports with students considering application for entrance into Penta-County in the fall of 1969. The reports were based on preliminary analyses conducted in the summer of 1968 with data available from 1966 and 1967 entrants. Students in the analysis groups had a GPA of "D" or better in vocational course work and had not dropped out of school.

Two types of reports were provided to the counselors--local stanine norms for the aptitude variables and a preliminary version of the similarity score report illustrated in Appendix B. The stanine norms were calculated separately for programs enrolling primarily males, primarily females, both males and females, and for the total sample. In order to provide perspective on the level of aptitude represented by the Penta-County student body, the total sample norms are presented as Table 19 in Appendix D.

Counselor reactions to use of the project reports can be summarized as follows:

1. The similarity scores were much more helpful than the local norms in counseling prospective Penta-County students.

2. The similarity scores were sometimes difficult to interpret, especially when a student's scores were all low or when a student questioned why his scores came out as they did.

3. Testing had to be completed earlier in the school year if there was to be adequate time for use of similarity scores in facilitating exploration of vocational program options.

As a result of these reactions, development of local stanine norms was discontinued; similarity score profiles were developed to facilitate similarity score interpretation; and feeder schools were urged to test potential Penta-County applicants late in the spring or early in the fall of the year preceding the late winter application deadline.

Field testing during the 1969-70 school year involved approximately 900 students enrolled in 12 of the 14 feeder high schools. All were potential Penta-County enrollees. The median number of students per school was 65 with the range being 30 to 185. Administration of all tests was completed by late fall, with five schools electing to test during the preceding spring.

In addition to the commercially-available test score reports, counselors received a set of experience tables, similarity score reports for each of their potential enrollees, similarity score profiles, and the interpretive manual mentioned previously. A half-day workshop was held to introduce counselors to project reports and data-information conversion procedures. Each school was visited at least once, and in several instances the project director observed or participated in the interpretation of similarity score reports and profiles.

Counselor reaction to the data-information conversion procedures used during the 1969-70 school year was sought both informally and via the 11-item survey sheet reproduced with a summary of counselor reactions in Appendix C. A meeting was held with the counselors in order to provide an opportunity for them to elaborate on their survey reactions. Audio-tape copies of the discussion during this meeting are available upon request.

Overall counselor reaction to the reporting procedures was quite encouraging. Suggestions for improvement chiefly involved modifications of the similarity score profiles to facilitate their introduction to students. As a result, a three-step procedure for profile introduction was developed for field tests during the 1970-71 school year. This procedure involves a series of three similarity score profiles conveying progressively more detailed information on the "why" of a student's similarity scores. Counselors can use all three profiles with some students, or just one of them--depending on student readiness and need. The first profile shows the positions of the various vocational programs as coordinate points on two factors. The second profile contains, in addition, an ellipse enclosing the factor scores of about 50% of the students in one of the vocational areas. The third profile has ellipses for all of the vocational programs, as illustrated by Figure 8. Examples of the first two profiles are presented in Appendix E.

An informal survey of student reaction to reporting procedures was also completed after the 1969-70 field tests. Nine of the 12 schools agreed to identify a "reasonably representative" sample of students who had received the reports. Various suggestions for doing this short of using a random number table were given. The median number of students surveyed per school was 10 with the range being 5 to 43. Student reactions to reporting procedures are summarized on the survey sheet reproduced in Appendix C. It is encouraging to note that few students viewed the similarity scores as telling them what to do (item 3), and that only 8% felt that the similarity scores were of no help in thinking about vocational program options (item 2). Student comments on the reporting procedures are especially refreshing. Who could feel disappointed by a test interpretation that ". . .told a little more about me that I didn't quite know"!

Student and counselor reactions will again be sought during 1970-71 field testing. In addition, cross-validation analyses of vocational program membership predictions based on similarity scores are planned. It will also be possible to compare the satisfaction ratings of students who did not enter programs to which they were similar with the ratings of those who did. Finally, project reports will be provided to one randomly-selected group of potential enrollees but withheld from another. The normal, commercially-available test score reports will be available for use in counseling members of both groups. When follow-up data become available, success and satisfaction comparisons will be conducted for the experimental and control groups.

Secondary objective

The secondary objective of this project was to develop and field-test a prototype package of computer programs designed to facilitate data-information conversion. The computer-based procedures that were

developed and implemented as part of this project have already been described. Interpretive reports prepared for counselors and counselees have been illustrated. The development of one of these reports--similarity score profiles--represents an unexpected project outcome.

Counselor and student response to field tests of project data-information conversion procedures resulted in the decision by the host vocational school district to continue project activities through use of its own funds and computer facilities. In addition, support was obtained from the Ohio Board of Regents to generalize the prototype package of computer programs that was developed. It would seem clear, on the basis of the above evidence, that the secondary objective of the project has been accomplished.

Discussion

In this study, aptitude and interest measures were found to be substantially more effective than the personality measures in differentiating students enrolled in the various vocational programs. Although this finding is in general agreement with the results of research reported by Keim (1967), Pucel and Nelson (1969), and Stewart (1966, 1968), it must be viewed with caution because of possible criterion contamination by the aptitude and interest measures. Ideally, all test score reports would have been withheld from counselors until after the validation analyses were completed. However, this was not possible from a practical standpoint; i.e., the study could never have begun. Instead, the commercially-available score reports for all measures except HSPQ and VIQ were provided to feeder school counselors with no direction as to how they should be used. If there were uniform biases in the interpretation of the score reports across the feeder schools, it is possible that these biases would be reflected in choice of vocational program by prospective Penta-County students. However, the success and satisfaction criteria that were used in the study should have reduced the effect of any criterion group contamination resulting from test interpretation. One would expect that students who had made poor program choices as a result of test interpretation biases would have been excluded from the analysis groups by these criteria.

Even if all of the test score reports could have been withheld, Penta-County enrollees would not have randomly assigned themselves to vocational programs. Other antecedent data would still have had an influence on their decisions. One can only hope that counselors will help students to view data--from whatever source--in proper perspective.

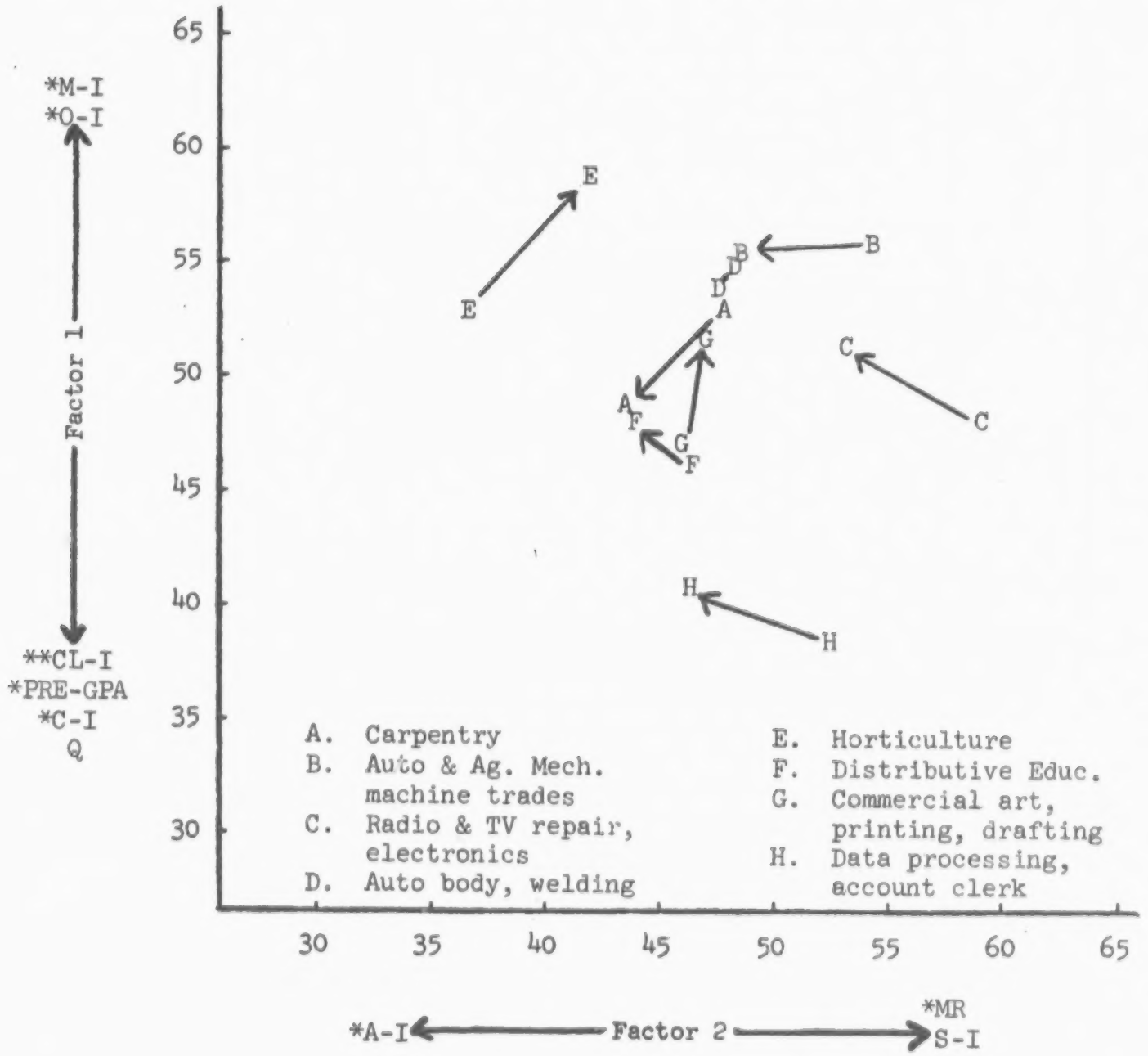
Empirical evidence on the possibility of criterion group contamination was obtained from analyses run on vocational program enrollees who did not meet the success and satisfaction criteria and, hence, were excluded from the analysis groups. One might reasonably expect differences between the factor scores of these "nonmembers" and their successful and satisfied counterparts. Figures 10 and 11 show the nature of these differences for the aptitude and interest variables combined. The factor positions of both members and nonmembers are based on equations obtained from the final analyses performed on members. The position of the nonmembers in relation to the members of each program group is indicated by an arrow pointing toward the nonmember group. Since several of the nonmember groups are rather small (as can be determined from Table 1), the results for those particular groups must be viewed with considerable caution.

In most cases, the member-nonmember differences appear to be plausible. For example, Figure 10 shows that the radio-TV repair and electronics nonmembers (area C) score further toward the artistic interest end of the second factor than their counterparts. The nonmembers also appear to be somewhat less able, as indicated by their position on the first factor. Likewise, Figure 11 shows that cooperative office education and office machines nonmembers (area K) score substantially lower than members on the clerical dimension represented by the first factor.

Figure 10

Distribution of M-MF Member-Nonmember Analysis Groups

on First Two Aptitude-Interest Factors



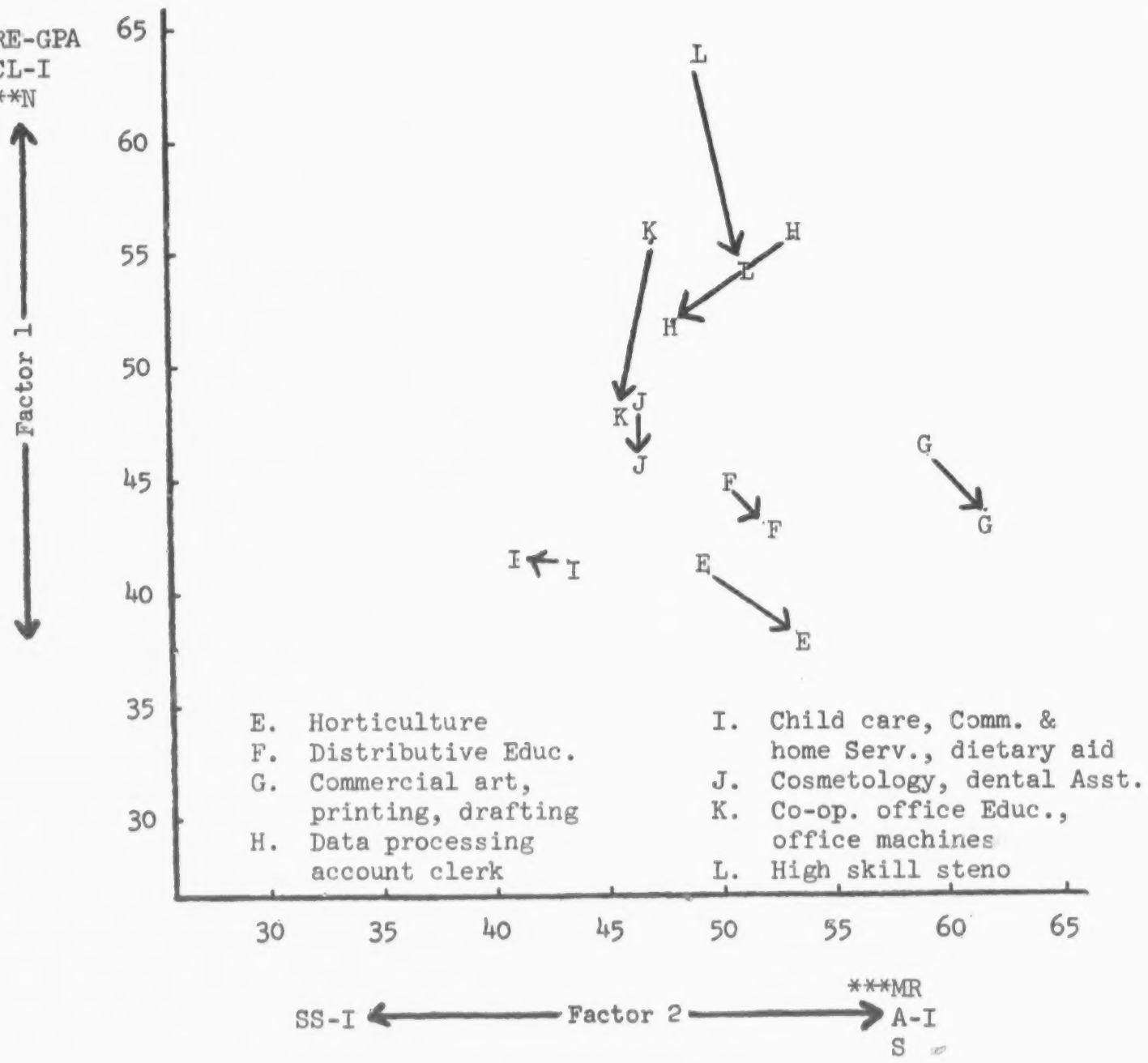
Note.--*** = r > .69; ** = r of .60-.69; * = r of .50-.59; no * = r of .40-.49. Variables having factor loadings with an absolute value of less than .40 are not listed as factor anchors.

Arrows point from member to nonmember groups.

Figure 11

Distribution of F-MF Member-Nonmember Analysis Groups

on First Two Aptitude-Interest Factors



Note.--*** = r ≥ .69; ** = r of .60-.69; * = r of .50-.59; no * = r of .40-.49. Variables having factor loadings with an absolute value of less than .40 are not listed as factor anchors.

Arrows point from member to nonmember groups.

Separate multivariate analyses of variance were also conducted for the M-MF and F-MF nonmember students. The differentiation achieved by the combined set of aptitude and interest measures was substantially less for nonmembers than for their successful and satisfied counterparts. Wilks' lambda failed to achieve significance at the .05 level for the HSPQ analyses. Thus, in accordance with results reported by D'Costa (1968), application of group membership criteria substantially improved the amount of group differentiation that was achieved. Figures 10 and 11 suggest that the improvement might be due, at least in part, to the elimination of students who had made inappropriate choices in terms of their aptitudes and interests. This would serve to reduce any criterion group contamination by the aptitude and interest measures.

The fact remains that the HSPQ results were not available to counselors, while the results from the aptitude and interest measures were. The large differences in group differentiation obtained for the two sets of variables might be explained on this basis although it seems highly unlikely.

The effectiveness of PRE-GPA as a predictor of vocational course grades was not unexpected. This finding is in agreement with results reported for vocational-technical programs at the community college level (Baird, 1969; Lunneborg & Lunneborg, 1969). Whether vocational programs grades should be related to prior academic grades is a matter of debate. Certainly, one would hope that prior GPA in academic courses would not be the only effective predictor of vocational course GPA. This study did produce evidence of differential validity among the other predictors that were used.

The data-information conversion procedures developed and implemented in this project can only aid, not replace, educational-vocational guidance and counseling. As a result of employing these procedures, one obtains information--nothing more, nothing less. Although this information can vary in accuracy and usefulness, it can make no decisions. Neither can it substitute for the day-to-day vocational development that students experience in an ongoing guidance program. Information is a necessary but not sufficient condition for good decision making (Clarke, Gelatt, & Levine, 1965).

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Evaluation. Cross-validation analyses of system-generated information are scheduled for the summers of 1970 and 1971. A survey of counselor and student reaction to TVIFS feedback reports will be obtained during the 1970-71 field trial. System revisions will be based on these reactions and operational experiences.

Project Director: Dale J. Prediger, Professor of Education, University of Toledo.

Supported by: U.S. Office of Education, Ohio Board of Regents, Penta-County Vocational School, University of Toledo Research Foundation.

APPENDIX A

TVIFS--Test Validation and Information Feedback System (A Computer-based Guidance Support System)

Objectives of system. TVIFS is a computer-based guidance support system that does not require student-computer interaction. The major purpose of the system is to transform test scores and other data into validated information readily useable in a counseling setting. Interpretive reports specific to individual counselees can be provided for many common guidance uses of test results. Through TVIFS, the counselor is relieved of much of the burden of data collection (including follow-up) and statistical analysis (including the extraction of useful information from analyses).

Description. TVIFS is a disk-oriented, modular system written in the FORTRAN programming language. Its three major functions are as follows:

1. Data collection, computer input, and random access storage.
2. Validation analysis by means of multiple discriminant analysis and regression packages.
3. Use of validation analysis results (when warranted) to generate the following types of feedback: (a) one- and two-way experience tables showing the relationship of test scores to criteria such as grades in specific courses or programs, persistence-dropout status, job satisfaction, etc.; (b) scores showing the similarity of a counselee's test results to the results of students in various criterion groups, e.g., academic programs, vocational programs, occupations, colleges; (c) similarity score profiles showing the performance of different criterion groups on the major discriminant factors represented in the test scores and/or other predictive data.

No restrictions have been placed on the tests that can be used. Other predictive data could include course grades, scaled ratings, attendance record, etc. Through use of correspondence tables, school or college progress data are accessible to TVIFS via the punched card or magnetic tape output normally developed by institutions having data processing equipment. Special data collection forms can be used by other institutions. Student follow-up, including selection of follow-up sample, printing of mailing labels, and tabulation of results, is performed by computer. Results of the follow-up become part of the data base and can be used in the validation analyses.

Current status. A prototype model of TVIFS was field tested during 1968-69 and 1969-70 academic years in 12 high schools associated with a vocational school district. Counselor and student reactions to interpretive reports were used to revise the portotype system and to develop specifications for TVIFS. With the exception of the post-high school and post-college follow-up components, TVIFS is scheduled to become operational by August, 1970. Development of the follow-up components and system field testing are scheduled for the 1970-71 academic year. Examples of interpretive reports and summaries of counselor and student reaction to previous field tests will be provided upon request.

APPENDIX B

WARNING: CONTENTS DANGEROUS UNLESS PROPERLY USED!

MANUAL FOR INTERPRETATION OF RESULTS

from

THE PENTA-COUNTY VOCATIONAL TEST BATTERY

Scene 137 from "A Developmental Guidance Program"

Time: Early fall

Place: High School Counselor's Office

Student (S): What vocational program should I take at Penta-County?

Counselor (C): That's a question only you can answer.

S: But what do the tests say I should do?

C: The tests only provide you with information you might want to consider in making a choice.

S: They won't tell me which program to enter?

C: That's right. But the test results, along with alot of other things you know about yourself and Penta-County, might help you make a choice when that time comes around.

S: I get the picture. And I guess the test results are just part of it.

C: A small part. (To himself) If I have done my job right.

MANUAL FOR INTERPRETATION OF RESULTS

from

THE PENTA-COUNTY VOCATIONAL TEST BATTERY

Dale J. Prediger

Director, PC-TU Project

University of Toledo

September, 1969

The research and development work reported herein was performed pursuant to a contract with the Office of Education, U.S. Department of Health, Education, and Welfare. Contractors undertaking such projects under government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

Full project title: Validation of Counseling-Selection Data and Evaluation of Supplementary Programs for Vocational School Students
Contract No. OE-3-60051169-0379 Project No. 5-1169

TABLE OF CONTENTS

SECTION		PAGE
I.	A POINT OF VIEW	1
II.	GRIST FOR THE PENTA-COUNTY VALIDITY MILL.	3*
III.	INTERPRETATION OF REPORTS	8
IV.	REPORT FORMS.	13*
	Student Similarity Report	14
	Centour Score Profile Charts.	15*
	Single Entry Experience Tables.	19
	Double Entry Experience Tables.	22
APPENDIX:	Summary of Statistical Analyses	28*

Note -- The items indicated by an asterisk (*) above have not been reproduced in this appendix since the same information has been presented in the body of the report.

A Point of View

The primary focus of the PC-TU Project over the past three years has been to develop objective and validated data which can be used by Penta-County District counselors in helping students select an appropriate vocational education program. By taking a close, statistical look at what happened to a large number of students who were tested prior to entry, we have attempted to determine just what the tests can tell us about potential Penta-County students. We wish to emphasize that we are not promoting tests as the panacea for educational and vocational guidance. We are promoting efforts to find out how well the tests counselors use do the job they want them to do. The package of computer programs being developed as part of the PC-TU Project should make it possible for counselors in other schools to take a close look at the effectiveness of their tests in achieving the objectives they have in mind.

This manual does not contain "all the answers." The reports that are presented will in no sense "tell Johnny what he ought to be." Neither will their proper use somehow make counseling cold and impersonal. Test results, whether or not they have been subjected to elaborate statistical analyses, are still only information, nothing more--nothing less. Although information can vary in accuracy and value, it can not make decisions. Neither can it substitute for the day-to-day vocational development that students experience in ongoing guidance programs. If properly used, however, test information can play an important role in such programs.

Timing has been identified as a crucial factor in the use of test data in vocational guidance. Test interpretations that are presented immediately before a decision point often have little positive value for a student. Hence, in working with a potential Penta-County student, district counselors making last minute use of the information in this manual may find that either (a) the student has already identified with a vocational program--made a personal commitment--and is not open to additional information; or (b) he is looking for something, anything, that will help him make a choice. In this latter instance, the information can become an electronic straw to be grasped in a last minute scramble for a decision. Counselors are urged to be aware of and guard against this possibility. The best safeguard would appear to be the use of test information early in the decision making process--when it is much more likely to take its place along with other information forming the basis for choice and commitment.

How (or whether) the information contained in this manual is used in working with students is a matter for professional judgment by each Penta-County District counselor. There is no backlog of interpretive experience with the types of reports presented here.

Indeed, one of the major purposes of the PC-TU Project is to get counselor and student reaction to the potential usefulness of these reports. There is no doubt that this manual contains a large amount of information about the relationship between test data and choice of and/or performance in Penta-County vocational programs. Whether this information is usable in its current form, or at all, remains to be determined. We think that it is.

Interpretation of Reports

The discussion that follows will concentrate on the meaning and interpretation of the reports contained in this manual. No attention is given to the various ways in which the information can be used with individuals or groups since the same principles that apply to the use of any test data in vocational counseling are appropriate here. The suggestions on interpretation of the Student Similarity Report are largely based on experience gained in the use of this report during the 1968-69 school year. As a result of the reactions of four Penta-County District counselors who participated in the try-out of a preliminary version, the Centour Score Profiles were developed. These profiles constitute a major addition to the reporting procedure and should serve to clarify the meaning of the similarity scores. The Student Similarity Report, the Centour Score Profiles, and the Single (and Double) Entry Experience Tables can all be used together in working with students.

To facilitate explanation, the test results of a fictitious student, Fred Cartesian, will be used. Assume that Fred is a sophomore who is thinking about attending Penta-County. Fred's similarity scores were reported on each of two labels, one of which we will assume has been pasted on the sample report form on the following page. Please read this form before proceeding.

Fred's similarity scores indicate that he is most similar to successful and satisfied students enrolled in Vocational Horticulture (area E). Approximately 87% of the students in this area scored further away from the group average than he did. Fred's second highest area was Carpentry (area A). His scores in three other areas, G, D, and F, are all about the same. The difference of three points between the scores for areas F and G certainly is of no practical importance. It would appear that the most appropriate points of departure for discussion with Fred would be Horticulture and Carpentry. Fred's results show very little similarity to students in areas H and C. This does not mean he should dismiss these areas from consideration. As noted on the report form, however, they may not be as well-suited to his abilities and interests as the other areas.

At the bottom of the label, Fred's factor scores are listed along with the Centour Score Profile Chart (IA) to which they apply. The factor scores have been plotted on the sample profile chart on the page following the Student Similarity Report. Inspection of this chart shows that Fred's scores do place him quite close to the typical student in Vocational Horticulture (represented by the capital E on the chart). Fred also scores close to the ellipse enclosing 50% of the students in Carpentry.

E X A M P L E

STUDENT SIMILARITY REPORT FOR PENTA-COUNTY VOCATIONAL PROGRAMS

If you are thinking about entering Penta-County Vocational School you probably face a difficult decision--the choice of which vocational program you wish to enter. This report won't tell you what to do. However, it will provide some information that might help you make a decision. The information can be helpful only if you, with the help of your counselor, CONSIDER IT ALONG WITH ALL THE OTHER THINGS you know about yourself and Penta-County programs.

Your scores are based on the aptitude and interest tests you took in the Penta-County Vocational Test Battery. Each score gives a rough estimate of your similarity to successful students in one of the vocational-program areas at Penta-County. The 24 programs at Penta have been grouped into 12 areas which are listed to the left and right of the box below. Notice that mostly boys enroll in areas A-D, in areas E-H a number of boys and girls enroll, and in areas I-L mostly girls enroll.

THE KEY POINT IS THIS: The higher your score for an area, the more similar you are to students in the vocational programs represented by that area. The highest score you can get is 100. The lowest score is zero. A zero score for area G would indicate that your test scores are quite different from those students who have "made it" in the commercial art, printing, or drafting programs at Penta. Please follow the steps below in order to prepare your report.

1. Paste the small, white label which has your name and eight scores on the large box shown below.
2. Rank your eight scores from highest to lowest. Give the highest score the rank of 1, etc. Enter the ranks on the line below your scores.

Vocational Areas

A. Carpentry
B. Auto & Ag. Mechanics, Machine Trades
C. Radio & TV, Electronics
D. Auto Body, Welding
E. Vocational Horticulture
F. Distributive Education
G. Commercial Art, Printing, Drafting

381034 FRED CARTESIAN 09/10/69

STUDENT SIMILARITY SCORES FOR P-C VOC. PROGRAMS

AREA =	A	B	C	D	E	F	G	H	I	J	K	L
SCORES =	41	14	03	26	87	25	28	01	0	0	0	0
RANK =	2	6	7	4	1	5	3	8	___	___	___	___
AREA =	A	B	C	D	E	F	G	H	I	J	K	L

FACTORS: 56, 36 CHART 1A PRE PC GPA 16

Vocational Areas (cont

H. Data Processing, Account Clerk
I. Child Care Aide or Ass't., Community Home Service, Diet Aide
J. Cosmetology, Dental Assistant
K. Co-op Office Educ Office Machines
L. High Skill Steno

SO HOW DO YOU USE THIS KIND OF INFORMATION? As a start, take a look at how your scores rank. Put a check beside the name of the areas ranking 1st, 2nd, and 3rd. These are areas that you might want to give special attention. Next, look at the areas in which you rank low. These may not be as appropriate for you as some other areas. Your counselor will help you figure out why your scores may have come out the way they did.

In order to judge how successful you might be in a given program, you must also consider whether you have the course preparation, specific aptitudes, and personal desire that is needed. This report does not tell you that. However, it does provide useful information for you to consider, with the help of your counselor, before making a choic

An earlier version of Figure 8 was inserted here.

By noting the anchors on the Factor 1 dimension, one can see that Fred probably has higher than usual scores in the mechanical and outdoor interest areas. At the same time, his score in the clerical interest area and his pre-PC GPA may be somewhat lower than usual. (Note.-- Computational interest and clerical perception aptitude were not listed as anchors on the original chart provided to counselors.) On Factor 2, Fred scores well toward the artistic interest end of the dimension. This may also reflect a relatively low level of mechanical reasoning aptitude and/or scientific interest since students scoring high on these measures typically get much higher factor scores. Of course, one can go to Fred's test score reports and high school record to check out these possibilities. For purposes of comparison, the means and standard deviations of all Penta-County students have been provided on a separate sheet.

Fred may wonder why his similarity scores were so low for the Data Processing area (area H). A look at the chart shows that these students are typified by relatively high clerical interests and pre-PC GPA (i.e., they typically score toward that end of Factor 1). At the same time they do not typically show the same level of artistic interest that Fred expressed. (See Factor 2.) A similar approach can be used with other students to gain some understanding of the reasons for high or low similarity scores. Whether-or-not the Centour Score Profiles are shown to the student will have to be a matter for counselor judgment.

In order to gain additional information on Fred's chances for success in various vocational areas, the Single (or Double) Entry Experience Tables can be consulted. We already know that Fred looks alot like the typical student in Horticulture. This, alone, would indicate that he might make about the same grades as the typical Horticulture student. However, the similarity scores and centour profiles were not developed to provide predictions of success. The experience tables presented in the report section of this manual are more appropriate for this purpose. The single-entry table for Horticulture gives a picture of the relationship between pre-PC GPA and vocational grades at Penta-County. This relationship is summarized by a Pearson-product-moment correlation coefficient of .55 as shown in the table. Assume that Fred's pre-PC GPA was 16 (C = 20) or about a C- or D+. This value appears in the lower left-hand corner of his similarity score label. Entering the table in the middle row, we see that in the past, 69% of the Horticulture students with a similar pre-PC GPA obtained a Penta-County vocational GPA which was higher than a straight C. On the other hand, reference to the single-entry table for the Data Processing and Account Clerk areas shows that, of the 40 students falling in Fred's score category, 49% plus 3% (or 51%) obtained a GPA which was higher than 20. One must remember, however, that the test information we have about Fred indicates that he is <u>not similar</u> to Data Processing and Account Clerk students. Hence, use of the experience table for that group is probably not appropriate.

The Double-Entry Experience Table for Horticulture requires the use of two measures--GATB-M scores and pre-PC GPA. The multiple correlation between these measures and PC vocational GPA was .60 as indicated in the table. Thus, the level of relationship is somewhat higher than when pre-PC GPA is used alone. Suppose that Fred's GATB-M score is 93. Reference to the double entry table for Horticulture shows that Fred's pre-PC GPA and GATB-M scores place him with students in the lower right-hand quadrant of the table. In the past, 60% of the Horticulture students in this "cell" obtained a PC vocational GPA of 21 or better. However, a special note of caution is warrented since fewer than 10 students had scores falling in this cell. Horticulture was the smallest group for which analyses were run. The number of predictor categories and cell frequencies was greater for every other group. Nevertheless, a definite trend that makes good sense from a measurement standpoint can be seen in the data.

Much more can be said about the interpretation of the data presented in this manual. However, it is difficult to anticipate all questions that may be raised. For this reason, it is the intention of the project staff to hold meetings with small groups of district counselors as the reports for their students become available. Questions and feedback from these counselors will have a major influence on the nature of future editions of this manual.

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F. Distributive Education
G. Commercial Art, Printing, Drafting

PASTE LABEL HERE

Vocational Areas (cont'd

H. Data Processing, Account Clerk
I. Child Care Aide or Ass't., Community & Home Service, Dietar Aide
J. Cosmetology, Dental Assistant
K. Co-op Office Educati Office Machines
L. High Skill Steno

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In order to judge how successful you might be in a given program, you must also consider whether you have the course preparation, specific aptitudes, and personal desire that is needed. This report does not tell you that. However, it does provide useful information for you to consider, with the help of your counselor, before making a choice.

SINGLE ENTRY EXPERIENCE TABLES (9/69)

Part 1

Students in each of the groups listed below entered Penta-County in September of 1966, 1967, and 1968. The Penta-County vocational area grade point average (GPA) is based on vocational course work (related and shop or lab) completed up to (a) time of graduation (Fall '66 and '67 entrants); (b) end of junior year (Fall '68 entrants); or (c) dropout. For each predictor category (row) in the table, the percent of students whose grades at Penta-County fell into each of the PC-GPA categories (columns) is shown.
A = 40, B = 30, C = 20, D = 10, and F = 00.

A. CARPENTRY

Predictor: Pre-PC GPA, r=.30, N=52

		PC Vocat. GPA F-C 00-20	C-A 21-40	Freq.
PREDICTOR	22-40	40%	60%	15
	18-21	17%	83%	18
	00-17	37%	63%	19

B. AUTO & AG. MECH., MACHINE TRADES

Predictor: Pre-PC GPA, r=.37, N=225

		PC Vocat. GPA F-C 00-20	C-B 21-30	B-A 31-40	Freq.
PREDICTOR	22-40	15%	50%	35%	60
	18-21	48%	42%	9%	66
	16-17	61%	34%	5%	41
	00-15	53%	34%	12%	58

C. RADIO & TV, ELECTRONICS

Predictor: Pre-PC GPA, r=.33, N=82

		PC Vocat. GPA F-C 00-20	C-B 21-30	B-A 31-40	Freq.
PREDICTOR	25-40	38%	58%	4%	24
	18-24	53%	37%	10%	30
	00-17	64%	36%	0%	28

D. AUTO BODY, WELDING

Predictor: Pre-PC GPA, r=.38, N=108

		PC Vocat. GPA F-C 00-20	C-B 21-30	B-A 31-40	Freq.
PREDICTOR	20-40	26%	48%	26%	31
	16-19	46%	39%	15%	41
	00-15	50%	42%	8%	36

SINGLE ENTRY EXPERIENCE TABLES (9/69)

Part 2

Students in each of the groups listed below entered Penta-County in September of 1966, 1967, and 1968. The Penta-County vocational area grade point average (GPA) is based on vocational course work (related and shop or lab) completed up to (a) time of graduation (Fall '66 and '67 entrants); (b) end of junior year (Fall '68 entrants); or (c) dropout. For each predictor category (row) in the table, the percent of students whose grades at Penta-County fell into each of the PC-GPA categories (columns) is shown.
A = 40, B = 30, C = 30, D = 10, and F = 00.

E. VOCATIONAL HORTICULTURE

Predictor: Pre-PC GPA, r=.55, N=41

		PC Vocat. GPA F-C 00-20	C-A 21-40	Freq.
PREDICTOR	19-40	14%	86%	14
	15-18	31%	69%	13
	00-14	93%	7%	14

F. DISTRIBUTIVE EDUCATION

Predictor: Pre-PC GPA, r=.38, N=79

		PC Vocat. GPA F-C 00-20	C-B 21-30	B-A 31-40	Freq.
PREDICTOR	20-40	36%	57%	7%	28
	15-19	67%	33%	0%	24
	00-14	70%	30%	0%	27

G. COMMERCIAL ART, PRINTING, DRAFTING

Predictor: Pre-PC GPA, r=.56, N=185

		PC Vocat. GPA F-C 00-20	C-B 21-30	B-A 31-40	Freq.
PREDICTOR	24-40	7%	57%	36%	44
	21-23	24%	57%	20%	46
	17-20	37%	54%	9%	46
	00-16	71%	27%	2%	49

H. DATA PROCESSING, ACCOUNT CLERK

Predictor: Pre-PC GPA, r=.52, N=113

		PC Vocat. GPA F-C 00-20	C-B 21-30	B-A 31-40	Freq.
PREDICTOR	27-40	20%	31%	49%	35
	21-26	18%	61%	21%	38
	00-20	50%	48%	3%	40

SINGLE ENTRY EXPERIENCE TABLES (9/69)

Part 3

Students in each of the groups listed below entered Penta-County in September of 1966, 1967, and 1968. The Penta-County vocational area grade point average (GPA) is based on vocational course work (related and shop or lab) completed up to (a) time of graduation (Fall '66 and '67 entrants); (b) end of junior year (Fall '68 entrants); or (c) dropout. For each predictor category (row) in the table, the percent of students whose grades at Penta-County fell into each of the PC-GPA categories (columns) is shown.
A = 40, B = 30, C = 20, D = 10, and F = 00.

I. CHILD CARE AIDE OR ASST., COMMUNITY & HOME SERVICE, DIETARY AIDE

Predictor: Pre-PC GPA, r=.42, N=128

		PC Vocat. GPA F-C 00-20	C-B 21-30	B-A 31-40	Freq.
PREDICTOR	20-40	13%	50%	38%	32
	17-19	30%	50%	20%	30
	14-16	40%	57%	3%	30
	00-13	58%	33%	9%	36

J. COSMETOLOGY, DENTAL ASSISTANT

Predictor: Pre-PC GPA, r=.47, N=171

		PC Vocat. GPA F-C 00-20	C-B 21-30	B-A 31-40	Freq.
PREDICTOR	25-40	11%	33%	57%	46
	22-24	18%	66%	16%	38
	18-21	31%	52%	17%	48
	00-17	44%	49%	8%	39

K. CO-OP OFFICE EDUCATION, OFFICE MACHINES

Predictor: Pre-PC GPA, r=.56, N=124

		PC Vocat. GPA F-C 00-20	C-B 21-30	B-A 31-40	Freq.
PREDICTOR	26-40	19%	52%	29%	31
	22-25	10%	68%	23%	31
	19-21	29%	58%	13%	31
	00-18	55%	45%	0%	31

L. HIGH SKILL STENOGRAPHY

Predictor: Pre-PC GPA, r=.70, N=61

		PC Vocat. GPA F-C 00-20	C-A 21-40	Freq.
PREDICTOR	31-40	0%	100%	18
	25-30	13%	87%	23
	00-24	40%	60%	20

DOUBLE ENTRY EXPERIENCE TABLES (9/69)

Part 1

Students in each of the groups listed entered Penta-County in September of 1966, 1967, and 1968. Table cells represent various combinations of scores on two predictors. The percent of those students falling in a given cell who obtained a Penta-County Vocational GPA of 21 or better (20 = C) is shown for each cell. An asterisk is used to indicate fewer than 10 cases in a cell. The Penta-County vocational area grade point average (GPA) is based on vocational course work (related and shop or lab) completed up to (a) time of graduation (Fall '66 and '67 entrants); (b) end of junior year (Fall '68 entrants); or (c) dropout.

Data for column and row totals appear as follows: J/K with L% given underneath. K = number of students with scores falling in the column (or row) indicated. J = the number of these students obtaining a GPA of 21 or better (20 = C). L% = (J/K) X 100.

A = 40, B = 30, C = 20, D = 10, and F = 00.

A. CARPENTRY: N=52

A double entry experience table not warrented by the results of a multiple correlation analysis.

B. AUTO & AG. MECHANICS, MACHINE TRADES: N=225

Predictors: Pre-PC GPA (vertical axis) and DAT-MR, R=.44

	DAT-MR Raw Scores 10-45	46-50	51-54	55-68	Total
22-40	64%	80%	94%	94%	51/60 85%
18-21	37%	45%	71%	57%	34/66 52%
16-17	33%*	36%	40%	50%*	16/41 39%
00-15	39%	25%*	40%	71%	27/58 47%
Total	23/54 43%	29/59 49%	35/55 64%	41/57 72%	

DOUBLE ENTRY EXPERIENCE TABLES (9/69)

Part 2

Students in each of the groups listed entered Penta-County in September of 1966, 1967, and 1968. Table cells represent various combinations of scores on two predictors. The percent of those students falling in a given cell who obtained a Penta-County Vocational GPA of 21 or better (20 = C) is shown for each cell. An asterisk is used to indicate fewer than 10 cases in a cell. The Penta-County vocational area grade point average (GPA) is based on vocational course work (related and shop or lab) completed up to (a) time of graduation (Fall '66 and '67 entrants); (b) end of junior year (Fall '68 entrants); or (c) dropout.

Data for column and row totals appear as follows: J/K with L% given underneath. K = number of students with scores falling in the column (or row) indicated. J = the number of these students obtaining a GPA of 21 or better (20 = C). L% = (J/K) X 100.

A = 40, B = 30, C = 20, D = 10, and F = 00.

C. RADIO & TV, ELECTRONICS: N=82

Predictors: Pre-PC GPA (vertical axis) and GATB-F,R=.41

	GATB-F Stand. Scores 30-85	86-170	Total
25-40	60%	64%	15/24 63%
18-24	36%	56%	14/30 47%
00-17	24%	55%	10/28 36%
Total	15/41 37%	24/41 59%	

D. AUTO BODY, WELDING: N=108

A double entry experience table not warrented by the results of a multiple correlation analysis.

DOUBLE ENTRY EXPERIENCE TABLES (9/69)

Part 3

Students in each of the groups listed entered Penta-County in September of 1966, 1967, and 1968. Table cells represent various combinations of scores on two predictors. The percent of those students falling in a given cell who obtained a Penta-County Vocational GPA of 21 or better (20 = C) is shown for each cell. An asterisk is used to indicate fewer than 10 cases in a cell. The Penta-County vocational area grade point average (GPA) is based on vocational course work (related and shop or lab) completed up to (a) time of graduation (Fall '66 and '67 entrants); (b) end of junior year (Fall '68 entrants); or (c) dropout.

Data for column and row totals appear as follows: J/K with L% given underneath. K = number of students with scores falling in the column (or row) indicated. J = the number of these students obtaining a GPA of 21 or better (20 = C). L% = (J/K) X 100.

A = 40, B = 30, C = 20, D = 10, and F = 00.

E. VOCATIONAL HORTICULTURE: N=41

Predictors: Pre-PC GPA (vertical axis) and GATB-M,R=.60

	GATB-M Stand. Scores 30-76	GATB-M Stand. Scores 77-170	Total
17-40	67%*	87%	17/21 81%
00-16	13%	60%*	5/20 25%
Total	6/21 29%	16/20 80%	

F. DISTRIBUTIVE EDUCATION: N=79

Predictors: Pre-PC GPA (vertical axis) and GATB

	GATB-Q Stand. Scores 30-101	GATB-Q Stand. Scores 102-170
20-40	67%	63%
15-19	21%	50%
00-14	20%	42%
Total	14/41 34%	20/38 53%

DOUBLE ENTRY EXPERIENCE TABLES (9/69)

Part 4

Students in each of the groups listed entered Penta-County in September of 1966, 1967, and 1968. Table cells represent various combinations of scores on two predictors. The percent of those students falling in a given cell who obtained a Penta-County Vocational GPA of 21 or better (20 = C) is shown for each cell. An asterisk is used to indicate fewer than 10 cases in a cell. The Penta-County vocational area grade point average (GPA) is based on vocational course work (related and shop or lab) completed up to (a) time of graduation (Fall '66 and '67 entrants); (b) end of junior year (Fall '68 entrants); or (c) dropout.

Data for column and row totals appear as follows: J/K with L% given underneath. K = number of students with scores falling in the column (or row) indicated. J = the number of these students obtaining a GPA of 21 or better (20 = C). L% = (J/K) X 100.

A = 40, B = 30, C = 20, D = 10, and F = 00.

G. COMMERCIAL ART, PRINTING, DRAFTING: N=185

Predictors: Pre-PC GPA (vertical axis) and GATB-P, R=.58

	GATB-P Stand. Scores 30-101	102-115	116-170	Total
24-40	90%	93%	95%	41/44 93%
21-23	62%	75%	92%	35/46 76%
17-20	64%	43%	78%	29/46 63%
00-16	19%	40%	38%*	14/49 29%
Total	31/63 49%	40/63 63%	48/59 81%	

H. DATA PROCESSING, ACCOUNT CLERK: N=113

Predictors: Pre-PC GPA (vertical axis) and GATB

	GATB-G Stand. Scores 30-102	103-170
27-40	60%	88%
21-26	85%	80%
00-20	44%	83%*
Total	32/57 56%	47/56 84%

DOUBLE ENTRY EXPERIENCE TABLES (9/69)

Part 5

Students in each of the groups listed entered Penta-County in September of 1966, 1967, and 1968. Table cells represent various combinations of scores on two predictors. The percent of those students falling in a given cell who obtained a Penta-County Vocational GPA of 21 or better (20 = C) is shown for each cell. An asterisk is used to indicate fewer than 10 cases in a cell. The Penta-County vocational area grade point average (GPA) is based on vocational course work (related and shop or lab) completed up to (a) time of graduation (Fall '66 and '67 entrants); (b) end of junior year (Fall '68 entrants); or (c) dropout.

Data for column and row totals appear as follows: J/K with L% given underneath. K = number of students with scores falling in the column (or row) indicated. J = the number of these students obtaining a GPA of 21 or better (20 = C). L% = (J/K) X 100.

A = 40, B = 30, C = 20, D = 10, and F = 00.

I. CHILD CARE AIDE OR ASST., COMMUNITY & HOME SERVICE, DIETARY AIDE: N=128

Predictors: Pre-PC GPA (vertical axis) and GATB-F,R=.47

	GATB-F Stand. Scores 30-79	80-100	101-170	Total
20-40	80%*	93%	83%	28/32 88%
17-19	64%	67%	86%*	21/30 70%
14-16	50%	57%*	69%	18/30 60%
00-13	40%	40%	45%	15/36 42%
Total	22/41 54%	30/44 68%	30/43 70%	

J. COSMETOLOGY, DENTAL ASSISTANT: N=171

Predictors: Pre-PC GPA (vertical axis) and GATB-F,

	GATB-F Stand. Scores 30-90	91-100	101-112	113-170	Total
25-40	100%	63%*	92%	93%	41/46 89%
22-24	71%*	80%	80%	91%	31/38 82%
18-21	55%	80%	50%	83%	33/48 69%
00-17	73%	36%	64%	50%*	22/39 56%
Total	31/41 76%	29/44 66%	31/43 72%	36/43 84%	

DOUBLE ENTRY EXPERIENCE TABLES (9/69)

Part 6

Students in each of the groups listsd entered Penta-County in September of 1966, 1967, and 1968. Table cells represent various combinations of scores on two predictors. The percent of those students falling in a given cell who obtained a Penta-County Vocational GPA of 21 or better (20 = C) is shown for each cell. An asterisk is used to indicate fewer than 10 cases in a cell. The Penta-County vocational area grade point average (GPA) is based on vocational course work (related and shop or lab) completed up to (a) time of graduation (Fall '66 and '67 entrants); (b) end of junior year (Fall '68 entrants); or (c) dropout.

Data for column and row totals appear as follows: J/K with L% given underneath. K = number of students with scores falling in the column (or row) indicated. J = the number of these students obtaining a GPA of 21 or better (20 = C). L% = (J/K) X 100.

A = 40, B = 30, C = 20, D = 10, and F = 00.

K. CO-OP OFFICE EDUCATION, OFFICE MACHINES: N=124

Predictors: Pre-PC GPA (vertical axis) and GATB-V ,R=.65

	GATB-V Stand. Scores 30-90	91-97	98-170	Total
25-40	67%*	85%	90%	33/39 85%
20-24	73%	71%	88%	36/46 78%
00-19	43%	60%	67%*	20/39 51%
Total	25/44 57%	27/37 73%	37/43 86%	

L. HIGH SKILL STENOGRAPHY: N=61

Predictors: Pre-PC GPA (vertical axis) and GATB-G ,R=.73

	GATB-G Stand. Scores 30-105	106-170	Total
31-40	100%*	100%	18/18 100%
25-30	73%	100%	20/23 87%
00-24	62%	57%*	12/20 60%
Total	21/29 72%	29/32 91%	

APPENDIX C

Surveys of Counselor and Student Reactions to Field Tests

1. "Summary of Reactions," i.e., Counselor reactions to field tests.
2. "Student Survey Summary," i.e., Student reactions to field tests.

SUMMARY OF REACTIONS

(with examples of counselor comments)

PC District Counselor

January 26, 1970

To: Penta-County District Counselors

From: PC-TU Project Office

Re: Feedback on Testing Reports (URGENT!)

There's been alot of blood under the bridge since the PC-TU Project began in January, 1966; and the time has come to get your final reactions to our efforts. You will have a chance to share your reactions with others during the February 3rd P-C District Counselors Meeting. However, we need to get some things on paper for use in the formal project report.

From the beginning, our goal has been to obtain validated test information that goes beyond the type of reports available through commercial publishers and scoring services. As you know, we are not promoting tests as the panacea for educational and vocational guidance. Rather, we see information from tests as properly taking its place along with all of the other information and experiences that go into the making of wise decisions.

The general purpose of the questions below is to obtain your professional estimate of the usefulness of the new reporting procedures provided this year. Please check the letter that best represents your response to each question. (This "multiple-choice" format is supposed to make your job easier!) Comments on your responses to the questions are welcome. Suggestions for changes in current project services or for additional services, etc. would also be appreciated.

Please return this survey to Louise Fought by FRIDAY, JANUARY 30TH. An extra survey has been included so that other counselors in your school who may have used the new reports can respond.

1. In what way were you able to make use of the Similarity Score Reports (blue forms)?

___ a. Group interpretation only
9 b. Both group and individual interpretation
2 c. Individual interpretation only
1 d. Other: Used own form for group interpretation and blue form with individuals.

2. **Do you feel that the Similarity Score Reports (blue forms) readily lend themselves to group interpretation?**

__9__ **Yes:** __2__ **No** __1__ No response--Used own form for group interpretation.

COMMENTS: One counselor answered "no" above because he felt that individual follow-ups after general group sessions were necessary (which they are). He did successfully communicate general concepts in groups, however.

3. **How useful do you feel the Similarity Score Reports (blue forms) are in helping students consider their possibilities at Penta-County?**

__5__ **a. Very useful**
__5__ **b. Of some value**
__2__ **c. Of little value**
____ **d. Of no value at all**

COMMENTS:

Reports came too late.

4. **In terms of usefulness in helping students consider their possibilities at Penta-County, how do the Similarity Score Reports (blue forms) compare with the regular test score reports available from commercial publishers (Kuder profiles, GATB cards, DAT-MR score lists, etc.)?**

__5__ **a. Much more useful than the regular test score reports used alone.**
__6__ **b. Somewhat more useful than the regular score reports used alone.**
____ **c. Generally add little, if anything, to the usefulness of the regular score reports.**
____ **d. Test data, in any form, is of little or no value in working with potential Penta-County students.**
1 No response

COMMENTS: The information on the similarity sheet is really the information the student wants to know. The Kuder amuses; the GATB informs, but the similarity scores direct their thoughts for specific consideration.

5. **What is your reaction to the Similarity Score Profiles (ellipse charts) as a way to facilitate the counselor's understanding of why a given student's Similarity Scores came out as they did?**

__1__ **a. The Profiles are of no value in providing insights into the reasons for a student's Similarity Scores.**
__5__ **b. The Profiles are of some value.**
__6__ **c. The Profiles are quite useful.**

COMMENTS: (Counselor who checked "C" above)--Except that I would not let the students in general find out I could do this because I would never have the time to do it with everyone.

(Counselor who checked "B" above)--Original ellipse charts with all ellipses on one sheet tend to be confusing. Did not have chance to use single ellipse approach [Introduced at mid-year].

6. What is your reaction to showing the Similarity Score Profiles (ellipse charts) to students as a means of facilitating their understanding of why their Similarity Scores came out as they did? (Assume that the two-stage process suggested in Feedback Bulletin No. 2 is followed, i.e., student is introduced to chart having only a single ellipse before being presented with a chart having all eight ellipses.)

1 a. The Profiles can be used with understanding by almost all potential Penta-County students.
5 b. The Profiles can be understood by a majority of these students.
3 c. A few students are able to understand the Profiles. However, most students would probably become confused.
2 d. Current format of "Similarity Score Profiles" is too confusing to permit use with any students.
1 Other--Depends on person doing interpretation & quality of explanation.

COMMENTS: Encouraged many students to take a closer look at the areas involved.

I must honestly say I have confused students here. I am getting better.

7. If you had ample time to use the Similarity Score Profiles (ellipse charts), would you use them with--

___ a. no students at all?
3 b. only those students with low Similarity Scores?
4 c. only those students asking questions about why their Similarity Scores came out as they did?
4 d. almost all students?
1 e. Other: Need more time to think about this.

COMMENTS: Also useful with students having high similarity scores in areas that surprised them. Why did they score so high?

(Counselor who checked "D" above)--Why limit its application? Why allow inhibitions to keep this useful technique from some students?

8. To what extent do you feel your students were able to put their Similarity Scores to good use?

2 a. Most students appeared to make very little, if any, use of their Similarity Scores.
7 b. Most students appeared to maintain proper perspective in using their Similarity Scores; i.e., they used them as one kind of information to be considered in exploring their possibilities at Penta-County.
___ c. Most students appeared to place too much emphasis or reliance on the Similarity Scores, e.g., they let the scores make decisions for them, jumped to unwarranted conclusions, etc.
3 d. Other: Difficult to tell

COMMENTS:

9. How useful do you feel the Experience Tables (single-entry and double-entry) presented in the "Manual for Interpretation of Results" were in helping your students think about their possibilities at Penta-County?

2 a. Very useful
5 b. Of some value
1 c. Of little value
___ d. Of no value at all
4 Other--not used, no time, etc.

COMMENTS:

10. In terms of usefulness with potential Penta-County applicants, how do the new reporting procedures <u>taken as a whole</u>, i.e.--Similarity Score Reports, Profiles, and Experience Tables--compare with the regular test score reports available from commercial publishers (i.e., Kuder profiles, GATB cards, DAT-MR score lists, etc.)?

7 a. Much more useful than the regular test score reports used alone.
2 b. Somewhat more useful than the regular score reports used alone.
2 c. Generally add little, if anything, to the usefulness of the regular score reports.
1 d. Test data, in any form, is of little or no value in working with potential Penta-County students.

COMMENTS: (Counselor who checked "D" above)--Students seem to have their minds made up about wanting to attend vocational school regardless of their test scores.
Needed results earlier.

11. What modifications, changes, etc. in the reporting procedures, forms, "Manual for Interpretation of Results," etc., would you like to see?

1. Separate similarity score labels for boys and girls. This would eliminate the zeros.

2. Identify area on ellipse profiles, rather than using a letter code.

3. The change made earlier (single ellipses for introduction) was a good one.

4. Possibly changing the heading of the blue form to something about exploratory. Maybe the word similarity makes the student assume he should go into an area in which he scored high.

5. Color coding the centour score profiles for easier reading.

6. I think perhaps a centour - profile for each area will help, so I am making (attempting to make) my own.

7. More time to use reports.

Date _____ School _____ Counselor _____

February, 1970

Dear Student,

Your school counselor has been trying out a new way of reporting test results to students who are thinking about going to Penta-County. Examples of the new report forms are attached. We would like to get your reactions to these forms so that they may be revised and improved. Your answers to the questions below will help us find out how we can do things better. Please check the one response to each question that best expresses your reaction.

1. Do you recall receiving a copy of the attached blue form with your Similarity Score label pasted on it? 154 Yes; 9 No; 3 I'm not sure

   If your answer is yes, please go on to the second question. Otherwise, print your name at the bottom of the page and wait until the others have finished.

2. Did you find the Similarity Scores reported on your copy of the blue form to be helpful as you thought about programs that you might enter at Penta-County?

   13 a) They really weren't of any help to me.
   100 b) They were of some help.
   41 c) They helped alot.

3. What was the main way in which the Similarity Scores were helpful to you? (Please check only one response. Circle the letter for any other responses that you would also like to check.)

Circled		
	12	a) They weren't of any help.
10	9	b) They told me which program I should enter.
15	59	c) They suggested programs that I hadn't thought about before. As a result, I looked into some of these programs.
12	52	d) They backed up the program choices I had already made.
22	21	e) They suggested that some programs I had been thinking about might not be as "right" for me as some other programs.
0	1	f) They told me that I shouldn't go to Penta-County.

4. The white form attached to this sheet has some red and blue ovals on it. Did you discuss a form like this with your counselor?

   56 Yes; 83 No; 15 I don't remember for sure

   If your answer is yes, please go on to the 5th question. Otherwise, go on to question 6.

5. Did the white form help you understand the ways in which your interests and abilities were similar to or different from students in various vocational programs at Penta-County?

   13 a) It helped alot.
   34 b) It gave me some help in understanding my similarities and differences.
   6 c) It wasn't of much help.
   3 d) It just got me confused.

6. This space and the back of this sheet are for YOUR COMMENTS on the new reports. Was there anything special you liked about them or something that could be improved??

See attached sheet for sampling of student responses.

Date _____ School _____ Name _____

STUDENT SURVEY SUMMARY (continued)

The quotations below are a sampling of the more interesting responses to item number 6 on the survey form. The item reads as follows: "This space and the back of this sheet are for YOUR COMMENTS on the new reports. Was there anything special you liked about them or something that could be improved??"

1. I think it helped to make me think about what I should take.

2. The reason they didn't help that much is because I already had my mind made up and I was gonna take cosmetology no matter what because I know I can do this well. I think these reports are good if you don't know what you want to take for sure. But otherwise if you know definitely what you want, I don't think there worth it. But you don't know who knows what they want. So I think its worth the time.

3. I think these tests helped me in trying to decide whether to take the P.C. program or look into another field. I liked the way it compared me to other students in a particular program. The discussion of these tests with the counselor helped me also.

4. When at first I saw my scores, it kind of dissapointed me to see such low scores but the circles helped explain why they were so.

5. It surprised me alot.

6. How many years do you have to have for Auto Body Repair man?

7. As long as there is a counselor or someone to go over the results and have the students understand them, I think this type of test is good and beneficial.

8. I liked it all right. But I wish they would translate the big words into small ones, and then I would probably understand it.

9. They help me a little on one hand and on the other hand they just confused me, not mutch but just a little bit.

10. I think the reports were very good. It in a way helped me make up my mind. Although I didn't score the highest in the field I'm planning to take, the reports were excellent guides.

11. Leave it like it is.

12. It didn't help. I wanted to take Cosmetology - and it showed that I only ranked 3rd in it. I still want to take Cosmetology, I really don't want Child Care. For a second choice, yes.

13. The results on similarity reports really helped my decision. I've changed my mind about my course completely, hopefuly for the better.

14. The reports told a little more about me that I didn't quite know.

APPENDIX D

Supplementary Data

1. Tables 11--14: Correlations of Variables with Third and Fourth Discriminant Factors

2. Tables 15--18: Distribution of Vocational Program Area Means on First Four Discriminant Factors

3. Table 19: Stanine Norms for all Programs at Penta-County

Table 11

Aptitude Variable Correlations with

Third and Fourth Factors

	M-MF analysis group		F-MF analysis group	
Variable	Factor 3	Factor 4	Factor 3	Factor 4
MR	-.03	.06	.27	.04
V	.21	-.04	.11	-.16
N	-.26	.55	-.10	.41
S	.28	-.39	.41	-.05
P	.25	.18	.47	.30
Q	.17	.40	.57	.17
K	.06	.07	.32	.32
F	-.07	.07	.39	-.02
M	.11	.14	.13	.59
PRE-GPA	-.40	-.28	-.23	-.07
VIQ	.12	-.02	-.09	-.36
NVIQ	.48	.16	.28	.07

Table 12

Interest Variable Correlations with

Third and Fourth Factors

	M-MF analysis group		F-MF analysis group	
Variable	Factor 3	Factor 4	Factor 3	Factor 4
O-I	-.30	-.22	-.28	.73
M-I	.20	.58	-.14	-.14
C-I	-.05	.24	-.64	-.40
S-I	.45	.31	-.08	-.21
P-I	-.32	.05	-.09	-.20
A-I	.29	.31	.19	.06
L-I	.20	-.43	.21	.14
MU-I	.29	-.32	-.09	.08
SS-I	-.37	.05	-.02	-.18
CL-I	-.13	.18	-.09	-.09

Table 13

Personality Variable Correlations with

Third and Fourth Factors

	M-MF analysis group		F-MF analysis group	
Variable	Factor 3	Factor 4	Factor 3	Factor 4
A-P	.04	.47	-.05	.42
B-P	.20	-.02	.20	-.35
C-P	-.06	-.01	-.03	.36
D-P	-.12	-.40	.01	-.30
E-P	.34	-.21	.03	-.39
F-P	-.25	.36	-.31	-.12
G-P	.08	.43	.19	.58
H-P	-.05	-.04	.44	.34
I-P	.36	.35	.38	.08
J-P	.21	-.02	.20	-.36
O-P	-.18	-.05	-.21	-.23
Q2-P	.14	.13	-.26	-.04
Q3-P	.36	.26	.12	.01
Q4-P	-.40	.05	-.39	-.37

Table 14

Correlations of Aptitude and Interest Variables Used in Final Analyses with Third and Fourth Factors

	M-MF analysis group		F-MF analysis group	
Variable	Factor 3	Factor 4	Factor 3	Factor 4
MR	.51	.24	.24	-.14
N			.12	.08
S	.45	.20	.40	.02
Q	.09	-.19	.55	.12
PRE-GPA	-.02	.60	.14	-.03
O-I	-.32	.38	-.48	.28
M-I	.01	.36		
C-I	-.15	.12	-.23	-.68
S-I	.07	-.18		
A-I	.71	.35	.25	.52
SS-I			.13	-.31
CL-I	-.09	-.01	-.25	-.09

Note.--A vacant cell indicates that the associated variable was not used with the analysis group.

Table 15

Distribution of Vocational Program Area Means

on First Four Aptitude Factors

Vocational area	Factor 1	Factor 2	Factor 3	Factor 4
M-MF analysis group				
A. Carpentry	46.1	47.3	47.8	46.9
B1. Auto & Ag. Mech.	44.9	51.6	49.5	51.3
B2. Machine trades	47.2	55.4	47.2	51.4
C. Radio & TV repair, electronics	50.8	55.7	50.7	49.4
D. Auto body, welding	44.6	47.4	49.4	49.0
E. Horticulture	51.4	38.6	50.6	47.8
F. Distributive Educ.	51.1	42.1	51.1	55.8
G. Commercial art, printing, drafting	52.1	51.2	53.1	49.4
H. Data processing, account clerk	61.0	50.0	47.6	50.0
F-MF analysis group				
E. Horticulture	42.6	46.7	46.4	45.7
F. Distributive Educ.	43.6	48.4	49.9	53.9
G. Commercial art, printing, drafting	44.1	56.4	51.1	50.9
H. Data processing, account clerk	52.3	54.8	47.3	48.3
I1. Child care	45.3	44.1	45.6	50.2
I2. Comm. & home Serv., dietary aid	44.0	40.0	48.7	48.8
J. Cosmetology, dental assistant	52.8	47.7	54.0	48.3
K. Co-op. office Educ., office machines	55.9	45.6	50.0	53.5
L. High skill steno	62.1	54.2	47.0	49.7

Note.--Program means are expressed on a standard score scale with $\underline{\bar{X}} = 50$ and $\underline{s} = 10$ for all groups combined.

Table 16

Distribution of Vocational Program Area Means

on First Four Interest Factors

Vocational area	Factor 1	Factor 2	Factor 3	Factor 4
M-MF analysis group				
A. Carpentry	51.9	52.9	48.0	49.6
B1. Auto & Ag. Mech.	56.3	49.0	49.1	51.0
B2. Machine trades	49.7	43.0	58.0	46.4
C. Radio & TV repair, electronics	56.6	47.4	51.4	51.3
D. Auto body, welding	53.7	50.8	49.4	51.6
E. Horticulture	53.0	58.0	42.5	42.2
F. Distributive Educ.	46.0	48.6	47.1	45.8
G. Commercial art, printing, drafting	45.8	55.6	53.2	51.1
H. Data processing, account clerk	43.6	44.5	45.3	51.6
F-MF analysis group				
E. Horticulture	56.0	50.5	47.2	62.8
F. Distributive Educ.	50.7	48.3	49.5	50.2
G. Commercial art, printing, drafting	51.6	57.8	50.4	49.5
H. Data processing, account clerk	45.6	48.9	44.1	47.8
I1. Child care	60.2	46.3	46.3	49.9
I2. Comm. & home Serv., dietary aid	53.9	44.7	51.5	50.4
J. Cosmetology, dental assistant	53.7	47.9	52.4	47.9
K. Co-op. office Educ., office machines	44.7	48.6	52.5	51.0
L. High skill steno	41.3	48.7	51.0	51.9

Note.--Program means are expressed on a standard score scale with $\bar{X}$ = 50 and s = 10 for all groups combined.

Table 17

Distribution of Vocational Program Area Means

on First Four Personality Factors

Vocational area	Factor 1	Factor 2	Factor 3	Factor 4
M-MF analysis group				
A. Carpentry	47.9	50.3	47.9	49.8
B. Auto & Ag. Mech., machine trades	47.0	49.2	50.6	50.5
C. Radio & TV repair, electronics	51.7	49.8	54.2	52.0
D. Auto body, welding	45.5	48.3	49.7	47.7
E. Horticulture	51.2	57.8	53.8	46.2
F. Distributive Educ.	51.0	48.9	50.2	52.8
G. Commercial art, printing, drafting	51.3	52.4	48.0	50.8
H. Data processing, account clerk	56.3	47.2	49.8	48.3
F-MF analysis group				
E. Horticulture	44.9	53.4	56.3	45.8
F. Distributive Educ.	48.1	50.4	46.9	49.5
G. Commercial art, printing, drafting	47.8	53.2	49.4	51.4
H. Data processing, account clerk	51.5	46.3	49.6	50.2
I. Child care, Comm. & home Serv., dietary aid	44.8	46.3	50.9	50.3
J. Cosmetology, dental assistant	52.1	50.5	48.3	47.6
K. Co-op. office Educ., office machines	52.5	50.4	50.9	51.8
L. High skill steno	56.9	50.0	53.0	50.4

Note.--Program means are expressed on a standard score scale with $\underline{\bar{X}} = 50$ and $\underline{s} = 10$ for all groups combined.

Table 18

Distribution of Vocational Program Area Means

on First Four Factors Obtained in Final Analyses

Vocational area	Factor 1	Factor 2	Factor 3	Factor 4
M-MF analysis group				
A. Carpentry	53.6	47.7	48.9	51.6
B. Auto & Ag. Mech., machine trades	56.5	53.5	48.9	50.7
C. Radio & TV repair, electronics	47.7	59.0	52.7	47.3
D. Auto body, welding	55.6	48.7	48.9	50.3
E. Horticulture	53.3	37.0	41.9	50.6
F. Distributive Educ.	46.9	46.4	47.4	40.2
G. Commercial art, printing, drafting	47.4	46.2	56.1	50.8
H. Data processing, account clerk	38.9	52.0	45.4	52.4
F-MF analysis group				
E. Horticulture	41.3	49.8	39.4	75.0
F. Distributive Educ.	44.9	50.6	48.9	48.9
G. Commercial art, printing, drafting	46.3	59.2	51.3	51.4
H. Data processing, account clerk	55.3	53.3	47.4	44.1
I. Child care, Comm. & home Serv., dietary aid	41.8	43.0	47.9	48.8
J. Cosmetology, dental assistant	48.3	46.1	54.9	49.6
K. Co-op. office Educ., office machines	55.5	46.6	49.4	52.6
L. High skill steno	63.4	49.1	49.1	72.2

Note.--Program means are expressed on a standard score scale with $\bar{X}$ = 50 and s = 10 for all groups combined.

Table 19

Stanine Norms for All Programs

at Penta-County

Stanine	MR[b]	NV-IQ[b]	General Aptitude Test Battery[a]								
			G	V	N	S	P	Q	K	F	M
9	67-59	63-57	140-119	141-115	144-122	153-131	160-139	146-127	148-125	155-126	157-124
8	58-55	56-53	118-114	114-107	121-116	130-125	138-131	126-120	124-117	125-117	123-115
7	54-52	52-49	113-109	106-101	115-110	124-118	130-123	119-113	116-109	116-109	114-104
6	51-48	48-45	108-103	100-96	109-104	117-110	122-113	112-106	108-101	108-99	103-96
5	47-42	44-40	102-96	95-92	103-97	109-102	112-104	105-99	100-92	98-91	95-87
4	41-37	39-34	95-89	91-87	96-90	101-94	103-96	98-94	91-84	90-81	86-78
3	36-32	33-27	88-84	86-82	89-83	93-84	95-88	93-89	83-76	80-72	77-67
2	31-29	26-20	83-77	81-77	82-74	83-75	87-80	88-84	75-67	71-64	66-59
1	28-10	19-5	76-40	76-40	73-40	74-40	79-40	83-40	66-40	63-40	58-40

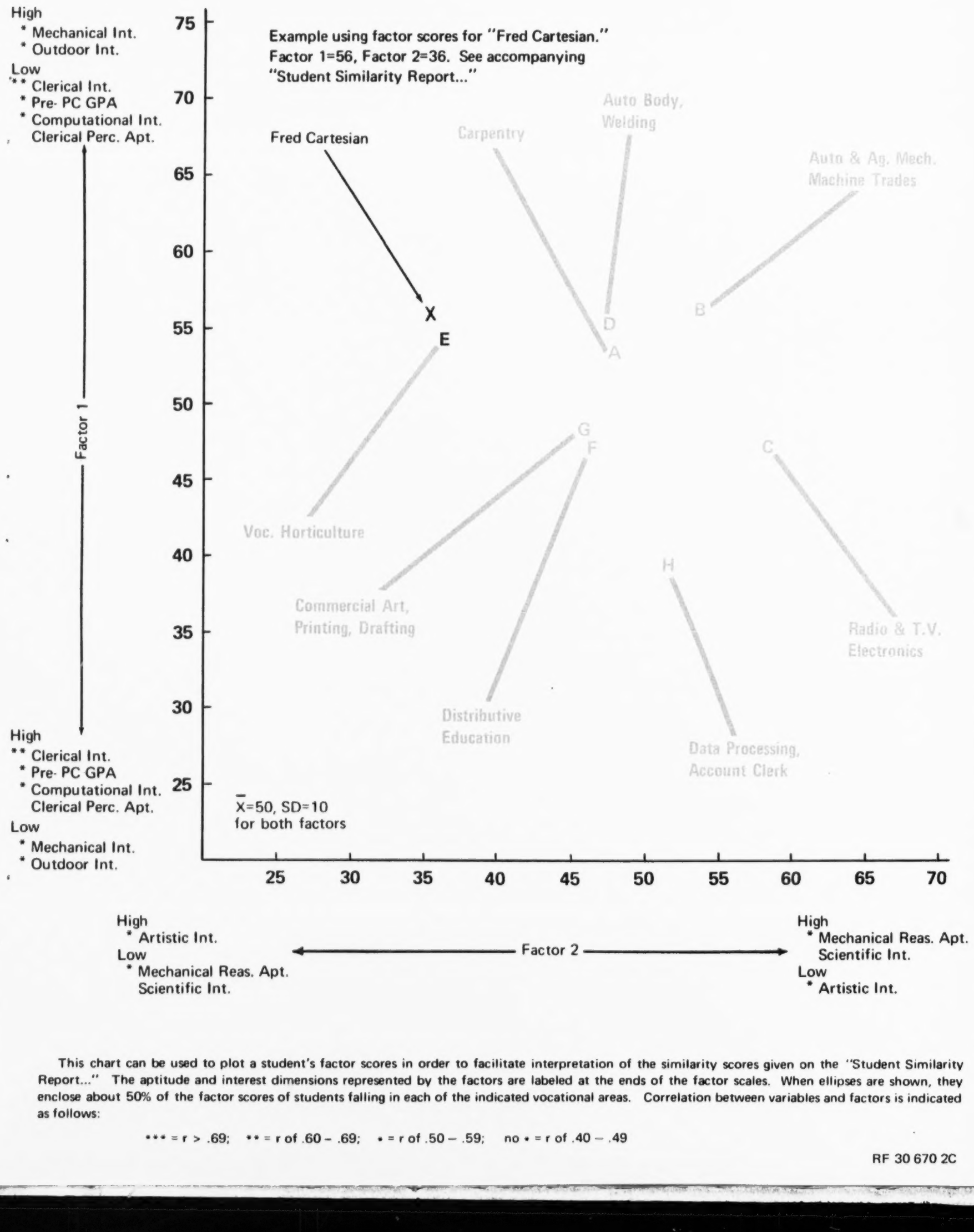
[a]Standard scores were used to develop stanines.

[b]Raw scores were used to develop stanines.

APPENDIX E

First Two Profiles in Similarity Score Profile Series

SIMILARITY SCORE PROFILES FOR PENTA-COUNTY VOCATIONAL AREAS
CHART IA: MALE AND MIXED GROUPS



This chart can be used to plot a student's factor scores in order to facilitate interpretation of the similarity scores given on the "Student Similarity Report..." The aptitude and interest dimensions represented by the factors are labeled at the ends of the factor scales. When ellipses are shown, they enclose about 50% of the factor scores of students falling in each of the indicated vocational areas. Correlation between variables and factors is indicated as follows:

*** = r > .69; ** = r of .60 – .69; * = r of .50 – .59; no * = r of .40 – .49

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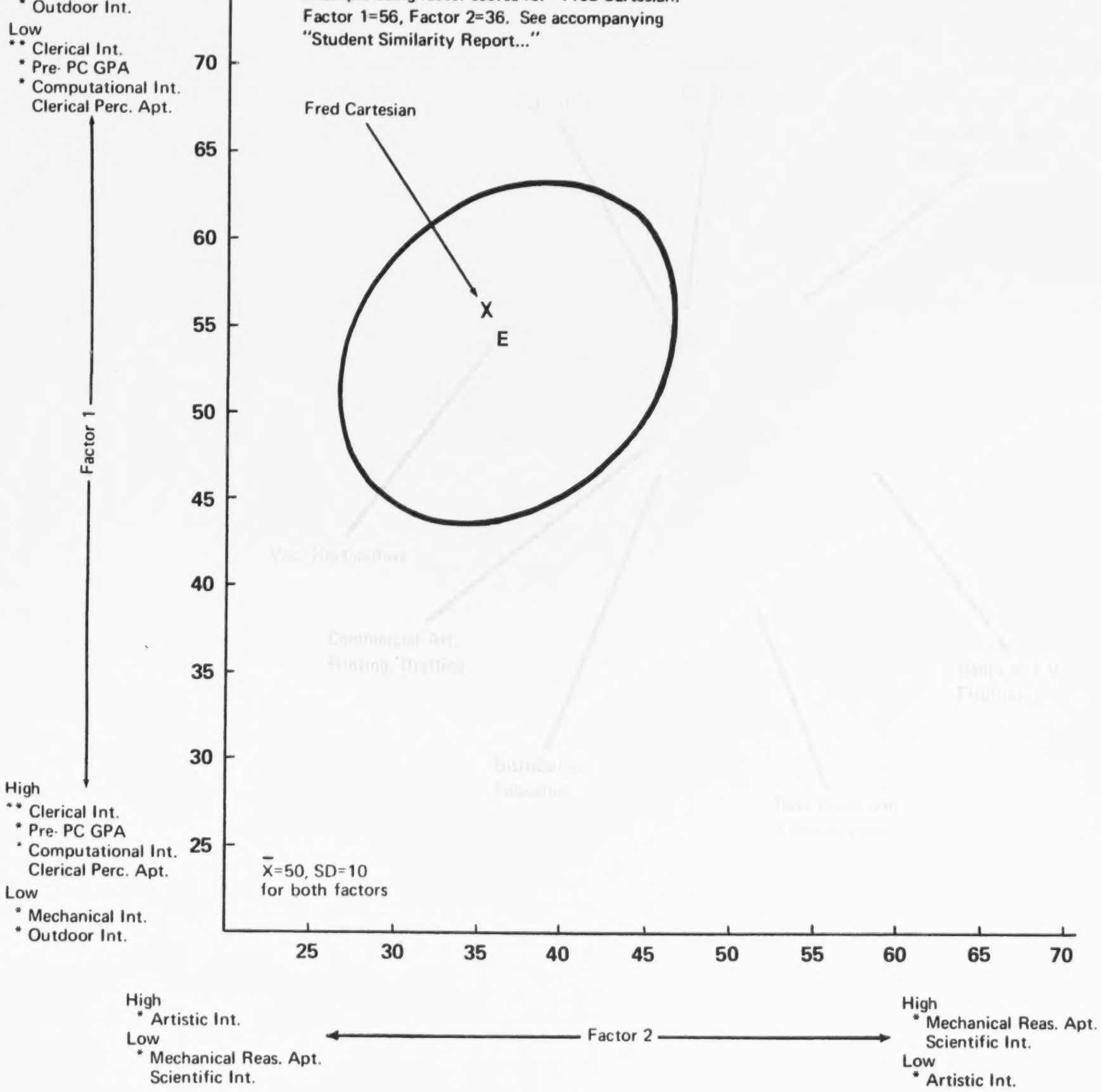
SIMILARITY SCORE PROFILES FOR PENTA-COUNTY VOCATIONAL AREAS
CHART IA: MALE AND MIXED GROUPS



This chart can be used to plot a student's factor scores in order to facilitate interpretation of the similarity scores given on the "Student Similarity Report..." The aptitude and interest dimensions represented by the factors are labeled at the ends of the factor scales. When ellipses are shown, they enclose about 50% of the factor scores of students falling in each of the indicated vocational areas. Correlation between variables and factors is indicated as follows:

*** = r > .69; ** = r of .60 – .69; * = r of .50 – .59; no * = r of .40 – .49

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